

2010
LUMMI NATION
WATER QUALITY ASSESSMENT REPORT
JUNE 28, 1993 TO DECEMBER 31, 2010

Prepared For:
Lummi Indian Business Council
(LIBC)



Funded By:
Environmental Protection Agency
(Grant No. BG-97042602-4)

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Date
March 2011

This project has been funded wholly or in part by the United States Environmental Protection Agency under Assistance Agreement BG-97042602-4 to the Lummi Nation. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

EXECUTIVE SUMMARY

The goals of the Lummi Nation Surface Water Quality Monitoring Program (Program) are to:

- a) Document ambient water quality and water quality trends on the Lummi Indian Reservation (Reservation);
- b) Evaluate regulatory compliance of waters flowing through and onto the Reservation, including compliance with Lummi Nation Surface Water Quality Standards; and
- c) Support the development and implementation of water quality regulatory programs on the Reservation.

The purpose of this report is to:

- a) Present the surface water quality data collected during the calendar year 2010;
- b) Compare the 2010 results to data from the period of record;
- c) Present interpretations of these data with respect to the Program goals; and
- d) Provide the U.S. Environmental Protection Agency (EPA) documentation required pursuant to the *Final Guidance of Awards of Grants to Indian Tribes under Section 106 of the Clean Water Act* (EPA 2006).

The Reservation consists of approximately 38 miles of marine shoreline and 7,000 acres of tidelands. Water quality on the Reservation is complex for several reasons. It is located in the estuaries of the Lummi River and the Nooksack River where marine and fresh water interact; the water column may have varying degrees of salinity-based stratification. In addition, water can flow upstream, downstream, or be stagnate at many of the sampling sites depending on the tides and weather conditions. Upland sites become saline or dry during the summer months as the dry season progresses. Once the wet season begins during October or November, upland flow increases, diluting many of the saline monitoring sites with fresh water.

The water quality parameters measured at the monitoring sites during 2010 generally followed the trends of 2003 through 2009 with elevated bacteria levels, higher temperatures, and lower dissolved oxygen levels compared to the Lummi Nation Water Quality Standards (LWRD 2008a). Fecal coliform bacteria levels in the mainstem of the Nooksack River at the Reservation border (SW118) improved during 2010 compared to the trends of 2003 through 2007. During 2010, fecal coliform bacteria levels at Site SW118 were lower than the Total Maximum Daily Load (TMDL) target of a geometric mean of 39 coliform forming units/100 ml established for the lower Nooksack River (Ecology 2000 and 2002) and met the fecal coliform water quality standards for Class AA fresh water bodies.

The marine waters of Lummi Bay and the Sandy Point Marina continue to have relatively good quality, while the surface waters within the Lummi River and Jordan Creek watershed continue to have the poorest water quality of the sites sampled on the Reservation. Sampling of the Nooksack River indicated variable water quality with elevated fecal coliform bacteria readings during 2010 that are a cause of concern even though improvements were observed compared to the 2003 through 2007 period. The decreased levels of fecal coliform bacteria

in the Nooksack River and in Portage Bay are a positive indication that the technical assistance and enforcement actions in the Nooksack River Basin are helping improve water quality. The continuing poor water quality in the Lummi River and tributaries to Lummi Bay, particularly with respect to increased fecal coliform bacteria contamination, is a major concern due to the potential for new closures of important tribal shellfish beds. The members of the Lummi Nation use these shellfish beds for ceremonial, subsistence, and commercial purposes.

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1. INTRODUCTION

The purpose of this introductory section is to present the goals of the Lummi Nation Surface and Ground Water Quality Monitoring Program (Program), identify Program staff changes during the reporting period, summarize Program improvements during 2010, and to provide an outline of the report contents.

1.1. Purpose Statement

The Program was initiated in June 1993 to establish the ambient conditions of Reservation surface waters, which are a component of the Lummi Nation Waters. This information is used to evaluate regulatory compliance of waters flowing through and onto the Reservation including compliance with Lummi Nation Surface Water Quality Standards (LWRD 2008a); to identify and track water quality trends; and to support the development and implementation of water quality regulatory programs on the Reservation.

The purpose of this report is to describe the Lummi Nation Water Quality Program and to present the surface water quality data collected during calendar year 2010; compare the 2010 results to data from the period of record, and present interpretations of these data with respect to the Program goals. This report is also intended to provide the U.S. Environmental Protection Agency (EPA) documentation required pursuant to the *Final Guidance of Awards of Grants to Indian Tribes under Section 106 of the Clean Water Act* (EPA 2006).

This report contains data collected pursuant to associated work plans and grant agreements between the Lummi Nation and the EPA. The data collected between January 1 and December 31, 2010 are presented in tabular form in Appendix A. These data were exported to EPA's Water Quality Exchange Network (WQX) on February 23, 2011. The data collected over the period of record is expected to be exported to WQX by December 31, 2012.

1.2. Program Staff Changes

Although the Water Resources Manager of the Lummi Water Resources Division (LWRD) of the Lummi Nature Resources Department (LNR) is responsible for the overall success of the Program, the responsibility for the operation of the Program is delegated to the Water Resources Specialist. In the past, the Water Resources Specialist supervised a Water Resources Technician, who performed most of the water quality sampling and data entry. The Water Resources Specialist left LNR during the spring of 2005, after 12 years of service including the initiation and development of the Program. The Water Resources Technician also resigned during the spring of 2005 after 7 years of service. These positions were filled during the spring and early summer of 2005, but both positions were again vacated during July and August 2006. The Water Resources Specialist position was refilled in October 2006 and the Water Resources Technician position was filled in February 2007. As these two staff members are the primary staff responsible for program implementation, and several months were required each time to select, hire, and train the replacements, substantially fewer water

quality samples were collected during 2005, 2006, and 2007 relative to previous and subsequent years. During winter of 2008, a GIS/Water Resource Technician III was hired to assist with water quality sampling. Training and familiarization with the program continued during the first half of 2008. During the second half of 2008, the Program stabilized and the frequency of sampling approached the schedule described in the *Lummi Nation Water Quality Monitoring Program Quality Assurance/Quality Control Plan – Version 4.0* (LWRD 2010b). During the spring of 2008, the Water Resources Specialist position was again vacated and the position was not re-filled until October 2008. During this period, the Water Resources Technician III was promoted to Water Resource Specialist I and assigned to lead the field data collection elements of the Program. The Program now consists of a Water Resource Specialist I and a GIS/Water Resource Technician III with additional support provided by a Water Resource Specialist II.

1.3. Program Improvements

When the Program was initiated in 1993, the collected data were recorded in field books and lab reports and then transcribed into computerized spreadsheets for analysis. The need to develop a database to manage the collected data was recognized by 1996 but the staff and financial resources needed to develop the database were not available. As more and more data were collected, the need to develop a database became increasingly urgent. Starting in 2005, an effort was initiated to develop improved data storage, management, and analysis capabilities. The first version of the resultant database was completed during 2006 (LWRD 2006a) and was initially populated with the water quality data from 2006. Because of the new database structure, the historic data stored in spreadsheets could not be simply imported electronically into the new database. As a result, a contractor was hired during 2007 and 2008 to enter all of the surface water quality data for the period from 1993 through 2008 into the new database. This task was completed in early October 2008. The current Water Resources Specialist I entered all of the November and December 2008 data and all subsequent data into the database. Historic data collected by the Washington Department of Health (DOH) in Portage Bay and in Lummi Bay is still being entered into the database. As part of the database development effort, standardized field data collection forms were developed to ensure that the required data were collected in the field and to facilitate the input of collected data into the database.

Beginning during 2010, continuous water temperature data were collected at 10 sites throughout the Reservation. The Water Quality Monitoring Database was not initially designed to manage continuously measured data from dataloggers used to record water level in wells or water temperature. During 2010, the Lummi Continuous Data Management System database (LNR 2010b) was developed to assist with data management specifically for continuous datasets.

In addition to the databases developed by LNR Staff members, a data analysis tool developed by Utah State University (USU) as part of the WRIA 1 Watershed Management Project (<http://wria1project.whatcomcounty.org>) became available. The Lummi Water Quality Monitoring database can export data in a format compatible with the USU data analysis tool, the STORET database, or the Excel spreadsheet program. The Lummi Water Quality

Monitoring and Lummi Continuous Data Management System databases are also able to perform limited analyses of the data. The graphical presentation in this summary report includes products that originate directly or indirectly from these two databases.

Efforts to make the Lummi Nation Water Quality Monitoring Program more accessible to the general public included the development of a LNR website during 2010. The most recent water quality assessment report, the Quality Assurance Program Plan, user guides for the databases, and other documents are posted on the website (<http://lnnr.lummi-nsn.gov/LummiWebsite/Website.php?PageID=56>).

1.4. Report Overview

This report is organized into the following sections.

- Section 1 is this introduction.
- Section 2 is a description of the Lummi Nation Waters and the Lummi Nation's Water Resources Management Program.
- Section 3 is a description of the surface and ground water quality monitoring objectives.
- Section 4 is a description of the Lummi Nation's surface and ground water quality assessment methods.
- Section 5 is a summary of the Lummi Nation Surface Water Quality Standards.
- Section 6 presents a comparison of the results from 2010 and the period of record to the Lummi Nation Surface Water Quality Standards and identifies trends in key water quality parameters at representative sites.
- Section 7 is a discussion of the water quality sampling results.
- Section 8 is a summary and conclusion section.
- Section 9 is a list of references cited in this report.

Appendix A presents the 2010 surface water quality data in tabular form. As noted above, these data were exported to the EPA Water Quality Exchange Network (WQX) on February 23, 2011.

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2. LUMMI NATION DESCRIPTION

The purpose of this section of the report is to describe the Lummi Indian Reservation location, Lummi Nation Water Resources Management Program, and provide an overview of the Lummi Nation Waters.

2.1. Lummi Indian Reservation

The Lummi Indian Reservation (Reservation) is located in the northwest corner of Washington State (Figure 2.1). The Lummi Nation is a federally recognized tribe with the Lummi Indian Business Council (LIBC) as its governing body. There are more than 4,500 enrolled members of the Lummi Nation. The Reservation is located along the western boundary of Whatcom County, Washington adjacent to Georgia Strait and Puget Sound. The Reservation includes portions of the Nooksack River and Lummi River watersheds, which drain into Bellingham Bay and Lummi Bay respectively. The Nooksack River drains a watershed of approximately 786 square miles, enters the Reservation near the mouth of the river, and discharges to Bellingham Bay (and partially to Lummi Bay during high flows). The Reservation is located approximately 8 miles west of Bellingham, 90 miles north of Seattle, and 60 miles south of Vancouver, British Columbia, Canada. The 2000 Census reported that the total Reservation population was 4,193 people. The 2010 Census results for the Reservation are expected to be published in May 2011.

2.2. Lummi Nation Water Resources Management Program

The Reservation is comprised of about 12,500 acres of upland and 7,000 acres of tidelands. Approximately 38 miles of highly productive marine shoreline surround the Reservation on all but the north and northeast borders. Much of the high-density development to date has occurred along the marine shoreline. Several new residential and municipal developments are planned for construction throughout the Reservation beginning during 2011. The Reservation includes the Nooksack River and Lummi River deltas, tidelands, forested uplands, Portage Island, and the Sandy Point Peninsula. Both the Nooksack River and Lummi River watersheds are under environmental pressures from rapid regional growth. The Lummi Nation has also entered a period of economic development under self-governance. Growth on and near the Reservation requires that the Nation's core environmental program prioritize the development of a regulatory infrastructure that is technically sound, legally defensible, and administratively efficient. This regulatory infrastructure needs to allow for growth while protecting tribal resources and the Reservation environment. This infrastructure will support both the tribal goals and EPA's policy of tribal self-governance and recognition of sovereignty.

Lummi Indian Business Council resolutions 90-88 and 92-43 directed the Water Resources Division of the Lummi Natural Resources Department to develop a comprehensive water resources management program that ensures that the planning and development of Reservation water and land resources are safeguarded against surface and ground water

degradation. Reliable information on the surface and ground water quality of the Reservation is required in order to effectively manage these resources.

The EPA and other federal agencies have previously supported the Nation's assessment of priority water resource needs and the identification of unmet needs. Environmental planning intended to protect the Nation's water resources has included development of a Wellhead Protection Program (LWRD 1997), a Storm Water Management Program (LWRD 1998), a Wetland Management Program (LWRD 2000), a Nonpoint Source Management Program (LWRD 2001, LWRD 2002), and Water Quality Standards for Reservation Surface Waters (LWRD 2008a). These programs are components of the Lummi Nation Comprehensive Water Resources Management Program (CWRMP). Important milestones in the program development effort include the adoption of the Lummi Nation Water Resources Protection Code (Title 17 of the Lummi Code of Laws) during January 2004, the adoption of surface water quality standards in August 2007, and the adoption of four Lummi Administrative Regulations in July 2010. The tribal water quality standards were approved by the EPA in September 2008.

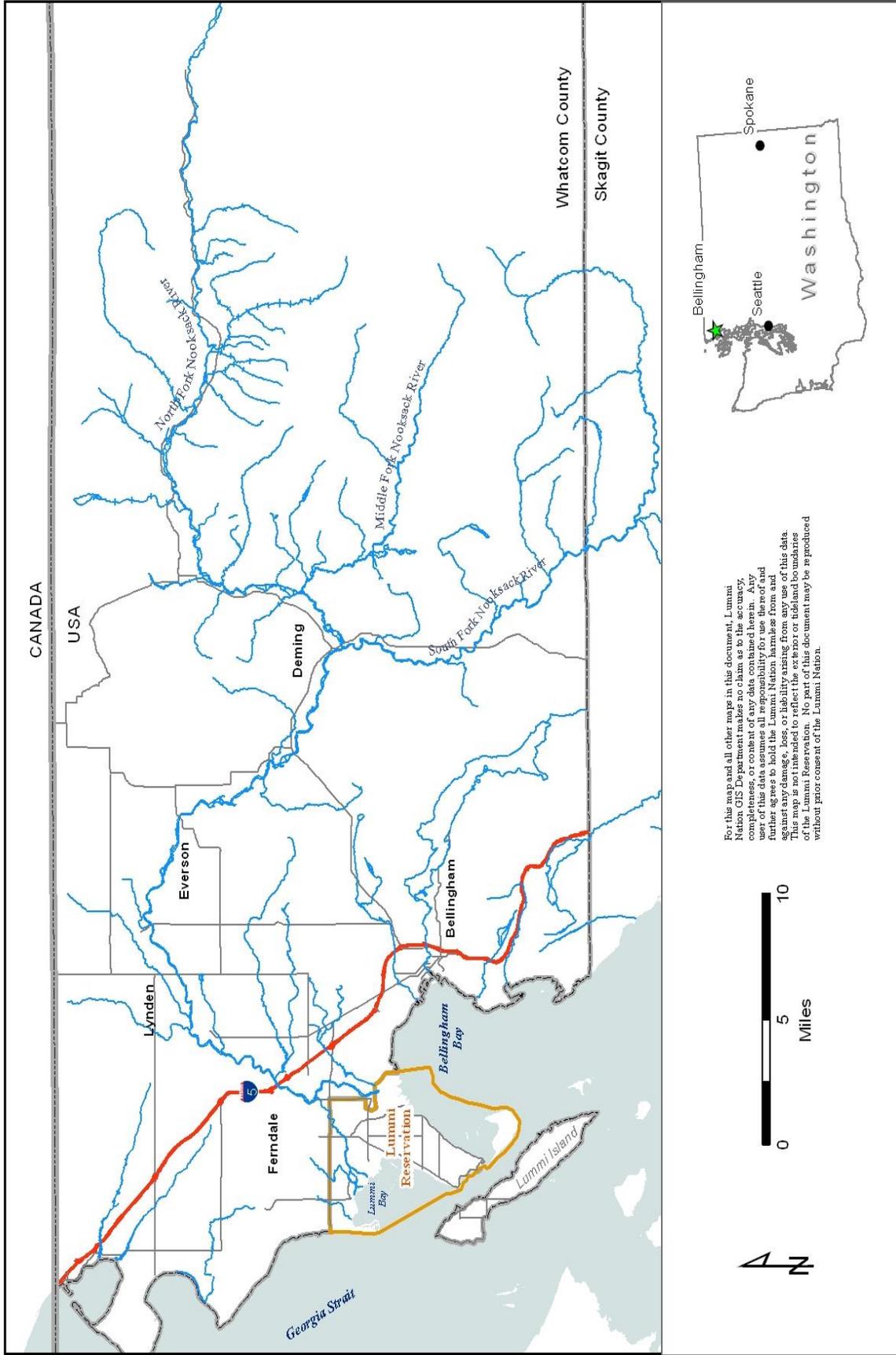


Figure 2.1 Regional Location of the Lummi Indian Reservation

2.3. Lummi Nation Waters

Lummi Nation Waters are all fresh and marine waters that originate or flow in, into, or through the Reservation, or that are stored on the Reservation, whether found on the surface of the earth or underground, and all Lummi Nation tribal reserved water rights (Lummi Code of Laws [LCL] 17.09).

2.3.1. Surface Water

The Lummi Nation is the largest fishing tribe in Puget Sound and has relied on their water resources since time immemorial for ceremonial, subsistence, and commercial purposes. There are 38 miles of marine shoreline surrounding most of the Reservation (except portions of the east boundary and the northern boundary). The surrounding tidelands are in the Strait of Georgia, Lummi Bay, Hale Passage, Portage Bay, and Bellingham Bay. In addition to marine waters, there are approximately 24.4 miles of rivers, streams, sloughs, and drainages on the Reservation including the multiple distributary channels of the Nooksack River delta. There are no lakes on the Reservation, but there are approximately 13 ponds. Finfish and shellfish spawn, incubate, and grow within and adjacent to Lummi Nation Waters (LNR 2010a). The Lummi Nation also operates one shellfish and two salmon hatcheries on the Reservation.

Eighteen watersheds are found on the Lummi Reservation. Reservation watersheds were delineated by the Lummi Water Resources Division as “A” through “T” (Figure 2.2) and vary in size from 218 acres up to 4,100 acres (LNR 2010c). The Nooksack River discharges to Reservation tidelands, but most of the approximately 786 square mile (503,040 acres) Nooksack River watershed is upstream of the Reservation. The 18 watersheds are aggregated into two primary drainage areas: Lummi Bay and Bellingham Bay (Figure 2.3). The Lummi Bay watershed is comprised of nine watersheds: C, H, I, K, L, O, P, Q, and R. It is noted that a portion of Watershed R discharges to Georgia Strait and that a portion of Watershed C discharges to Hale Passage. The Bellingham Bay watershed is also comprised of nine watersheds: A, B, D, E, F, G, J, S, and T. It is noted that all of Watershed A discharges to Hale Passage and that a portion of Watershed D also discharges to Hale Passage. As shown in Table 2.1, 11 of the 18 watersheds are completely within the Reservation boundary. Approximately 0.1 percent of the Nooksack River watershed (Watershed S) is on the Reservation.

There are eleven defined rivers, streams, sloughs, and drainages in the Lummi Bay and Bellingham Bay watersheds (Figure 2.3). Streams on the Reservation are classified as either Category 1 or Category 2 streams (LCL Title 17.06.080). Category 1 streams are all streams that flow year-round during years of normal rainfall or are used by juvenile or adult salmonids. Category 2 streams are all streams that are intermittent or ephemeral during years of normal rainfall and are not used by juvenile or adult salmonids. Of the eleven defined rivers, streams, sloughs and drainages, there are six Category 1 streams and five Category 2 streams on the Reservation. All other agricultural ditches and unnamed drainages are classified as Category 2 streams. As shown in Table 2.2, there are approximately 24.4 miles of streams, rivers, sloughs, and drainages on the Reservation. Jordan Creek, Lummi River, Smuggler’s Slough, Slater Slough, Schell Creek, Onion Creek, and Seapond Creek are

included in the Lummi Bay watershed. The Bellingham Bay watershed is comprised of the Nooksack River, Kwina Slough, Lummi Shore Road streams, and Portage Island streams. Five streams, rivers, sloughs, and drainages are completely within the boundaries of the Reservation.

Prior to 1860, the Nooksack River discharged to Lummi Bay rather than to Bellingham Bay (Deardorff 1992, WSDC 1960). The river flow was redirected to Bellingham Bay at that time and currently the Lummi River only receives water from the Nooksack River when the Nooksack River flows exceed approximately 9,600 cubic feet per second (cfs). The Lummi River currently drains much of the area west of the Nooksack River in the vicinity of Ferndale, Washington. The Nooksack River drains most of western Whatcom County, including most of the forested uplands and the developed lowlands.

The Nooksack River flow is comprised of ground water and precipitation throughout the year supplemented by glacial melt and snowmelt from Mount Baker and adjacent peaks of the Cascade Mountain range during the summer months. The Nooksack River supports several important species of salmon and other aquatic life. The Nooksack River delta is part of the Reservation and is part of an important marine wetland-estuary complex. There are water quality and water quantity challenges in the Nooksack watershed due to land development and agriculture. Whatcom County, which includes all of the lowlands in the Nooksack River watershed, had 167 dairy operations in 2005. All or portions of approximately 220 acres of tribal shellfish beds in Portage Bay were closed to commercial harvest over the November 1996 to May 2006 period due to bacterial contamination attributed to poor dairy nutrient management practices in the Nooksack River watershed (DOH 1997, Ecology 2000).

Nearly all of the water bodies in the Lummi River and Nooksack River floodplains are exposed to marine influences, which include the presence of saline water, salinity-based-stratification (stratification), and upstream flow during high tide. Most of the water quality sample sites are tidally influenced (water level and/or salinity) and have variable water column profiles (e.g., stratified or well-mixed) and salinities. In addition, upland sampling sites become saline or dry during the summer months as the dry season progresses. Once the wet season begins during October or November, flow from the uplands increase, diluting many of the saline monitoring sites with fresh water.

The 1999 comprehensive wetland inventory on the Lummi Reservation (LWRD 2000) indicated that approximately 43 percent (5,432 acres) of the Reservation upland areas are either wetlands or wetland complexes (Figure 2.4). Of these Reservation wetland areas, about 60 percent are located in the floodplains of the Lummi River and Nooksack River. Wetland complexes are areas where wetlands form a highly interspersed mosaic with upland hummocks. During the 1999 wetland inventory, boundaries were drawn around the outer edges of the mosaics and the entire areas labeled as “wetland complexes”. As a result, the estimated wetland area identified in the 2000 inventory generally represents more wetland area than actually exists. All wetland boundaries mapped during the comprehensive wetland inventory are general boundaries based on soil survey mapping and interpretation of color and infrared aerial photographs with some field verification. More accurate wetland boundaries are being delineated on the ground as needed for specific activities and as part of

an overall effort to improve the spatial accuracy of the wetland Geographic Information System (GIS) database. As of 2009, approximately 155 wetlands and 2,216 acres of wetland area have been evaluated as part of the 1999 wetland inventory update (LWRD 2010a).

The majority of the estuarine wetlands of the Lummi and Nooksack rivers will be protected and functionally improved in the future through the implementation of the Lummi Nation Wetland and Habitat Mitigation Bank. The mitigation bank will be developed in phases. Phase 1A, which encompasses most of the Nooksack River estuary, is schedule to be in operation during calendar year 2011. The area will be protected into perpetuity through a conservation easement. Enhancement measures like invasive species control and under planting with conifers will improve the ecological functions of the estuary. The mitigation bank will be used to mitigate unavoidable impacts to habitat and wetlands on the Reservation, but credits will also be available for purchase within the service area of the bank (LWRD 2008b).



Figure 2.2 Lummi Nation Watersheds

Table 2.1 Acres of Watersheds On-Reservation and Off-Reservation

	Basin ID	Total Watershed Area (acres)	On-Reservation Watershed Area (acres)	Off-Reservation Watershed Area (acres)	On-Reservation Percent of Watershed
Lummi Bay Watershed	C	494	494	0	100
	H	549	549	0	100
	I	1,059	1,059	0	100
	K	4,091	3,354	737	82
	M	Combined with Watershed L			
	N	Combined with Watershed O			
	L	2,307	134	2,173	6
	O	2,747	1,552	1,195	57
	P	4,097	227	3,870	6
	Q	1,096	570	526	52
	R	721	695	26	74
Bellingham Bay Watershed	A	280	280	0	100
	B	617	617	0	100
	D	797	797	0	100
	E	218	218	0	100
	F	326	326	0	100
	G	883	883	0	100
	J	134	134	0	100
	S	515,914	640	515,274	0.1
	T	393	393	0	100

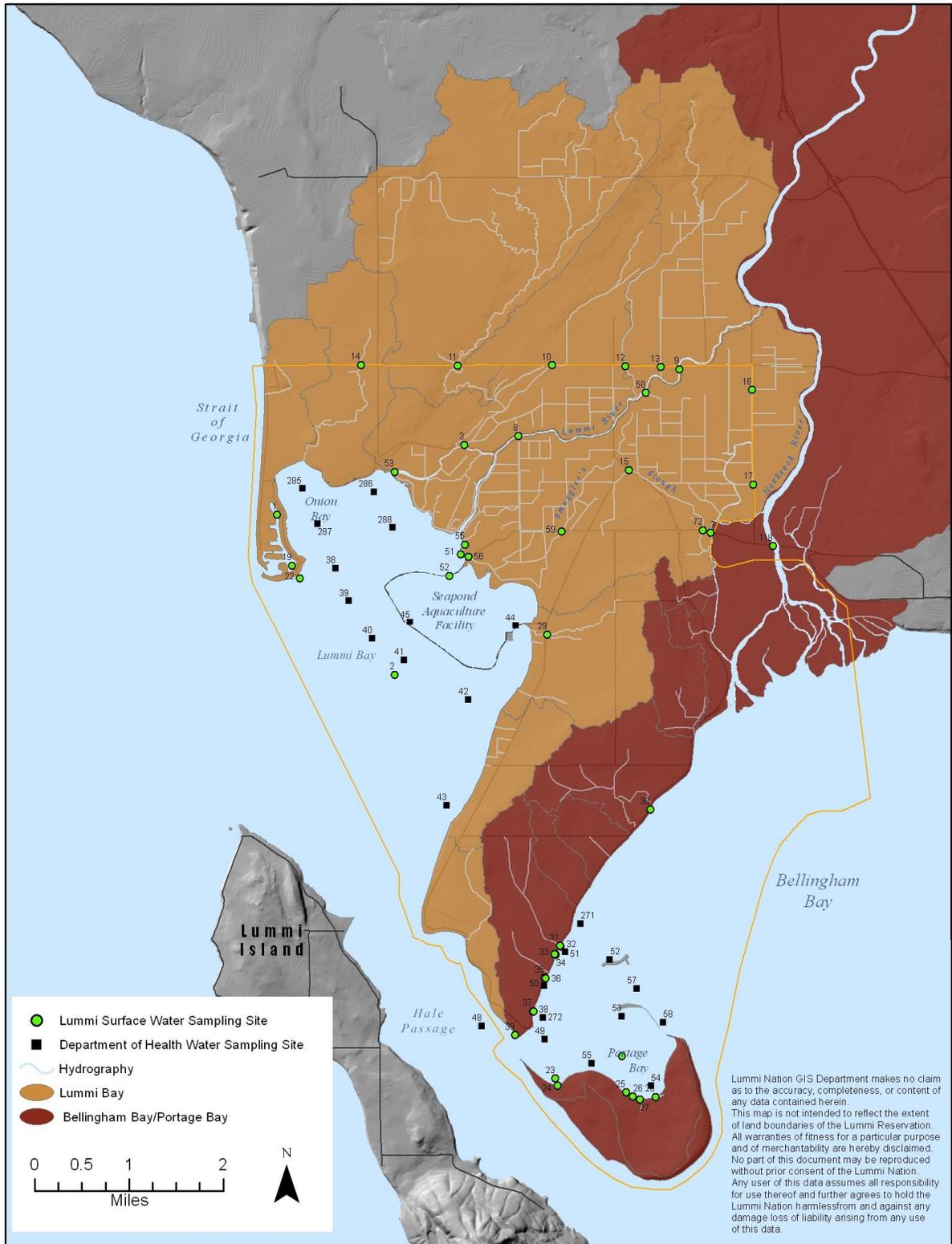


Figure 2.3 Lummi Bay and Bellingham Bay Drainage Areas

Table 2.2 River and Stream Miles On-Reservation and Off-Reservation

	River/ Stream	Stream Category	Total Stream/ River Miles	On-Reservation Stream/ River Miles	Off-Reservation Stream/ River Miles	On-Reservation Percent of Stream/ River Miles
Lummi Bay Watershed	Jordan Creek	1	6.6	2.1	4.5	32
	Lummi River	1	5.0	3.6	1.4	70
	Smuggler's Slough	1	3.9	3.9	0	100
	Slater Slough	2	1.3	1.3	0	100
	Schell Creek	1	4.1	0.4	3.7	10
	Onion Creek	2	2.2	1.8	0.4	81
	Seapond Creek	2	1.7	1.7	0	100
Bellingham Bay Watershed	Nooksack River	1	150	5.1*	144.9	3
	Kwina Slough	1	2.3	2.1	0.2	91
	Lummi Shore Road Streams	2	2.3	2.3	0	100
	Portage Island Streams	2	0.1	0.1	0	100

* Includes all the distributary channel lengths in the Nooksack River delta.



Figure 2.4 Lummi Nation Wetland Areas

2.3.2. Ground Water

Two separate potable ground water systems occur on the Reservation. One system is located in the northern upland area. This northern system flows onto the Reservation from the north and drains to the west, south, and east (Aspect Consulting 2009). The second potable ground water system is located in the southern upland area of the Reservation (Lummi Peninsula) and is completely contained within the Reservation boundaries (LWRD 1997, Aspect Consulting 2003). The floodplain of the Lummi and Nooksack rivers, which contains a surface aquifer that is saline (Cline 1974), separates the two potable ground water systems (Figure 2.5). A third potable ground water system may exist on Portage Island, but information on the water quality and the potential yield of this system is limited and inconclusive. Over 95 percent of the potable water used by Reservation residents is pumped from the Reservation aquifers. Because of the proximity to marine waters and the local geology, the aquifers on the Reservation are subject to both horizontal and vertical saltwater intrusion if wells are over-pumped (LWRD 1997).

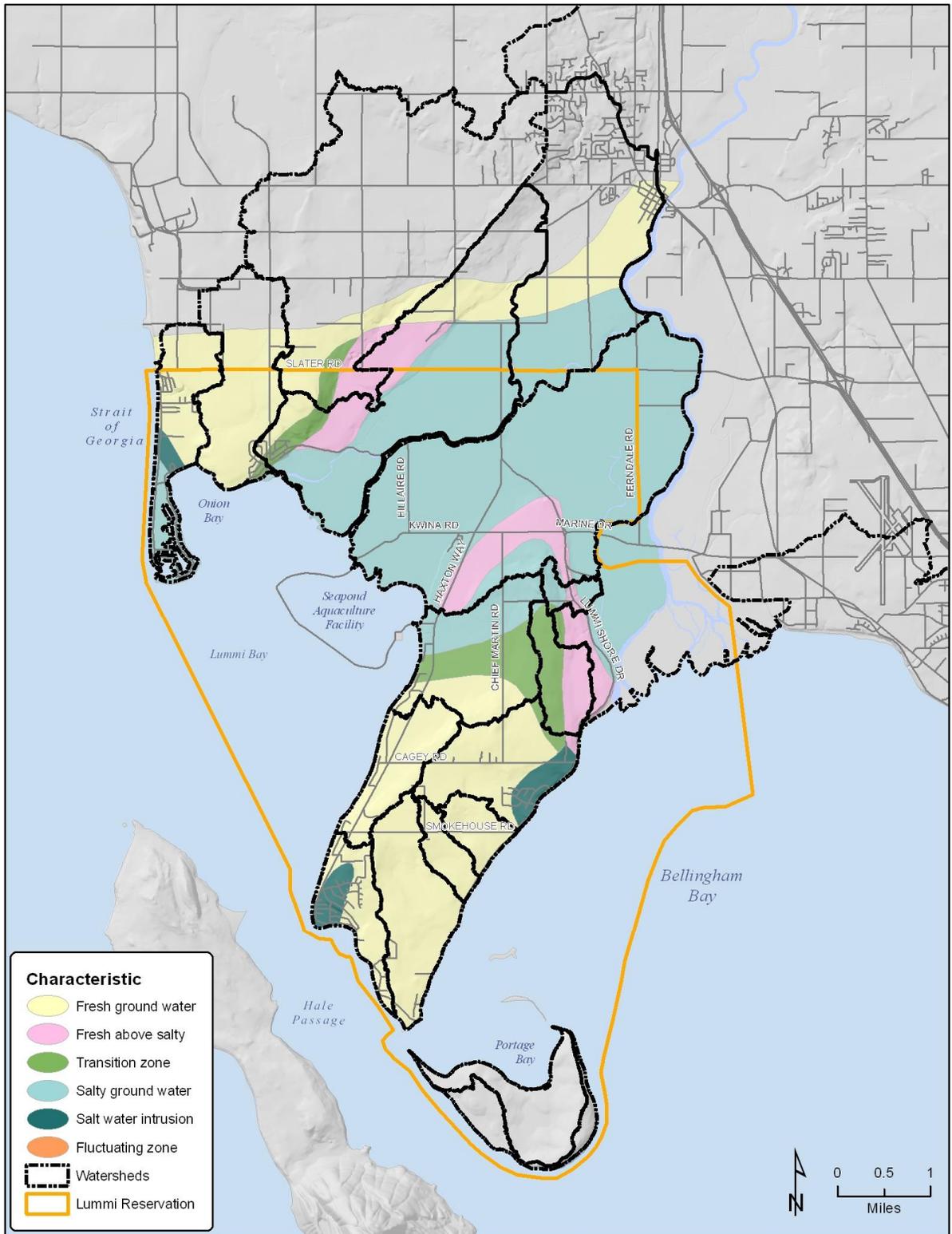


Figure 2.5 Lummi Reservation Ground Water Characteristics

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3. WATER QUALITY MONITORING OBJECTIVES

The purpose of this section is to describe the goals of the Lummi Water Resources Division (LWRD), the long-term water quality monitoring objectives, the Surface Water Quality Monitoring Program objectives, and the Ground Water Quality Monitoring Program objectives.

3.1. Lummi Water Resources Division Goals

The LWRD is responsible for protecting, restoring, and managing Lummi Nation water resources, including the Reservation shorelines, in accordance with the policies, priorities, and guidelines of the Lummi Nation. The overall goal of the LWRD is to protect the treaty rights to water of sufficient quantity and quality to support both the purposes of the Reservation as a permanent, economically viable homeland for the Lummi People, and to support a sustainable harvestable surplus of salmon and shellfish.

3.2. Long-Term Water Quality Monitoring Objectives

The Lummi Nation Surface and Ground Water Quality Monitoring Program (Program) has been ongoing since 1993. The goal of the Program is threefold: (1) to establish the baseline conditions of surface and ground waters on and flowing through and onto the Reservation, (2) to use this information to evaluate regulatory compliance of waters flowing through and onto the Reservation, and (3) to support the development and implementation of a water quality regulatory program on the Reservation.

The water quality monitoring objectives to help achieve the overall LWRD and the Program goals include:

1. Monitor surface and ground water quality at representative locations and at frequencies sufficient to establish baseline conditions of Lummi Nation Waters.
2. Monitor surface waters for compliance with the Lummi Nation surface water quality standards to support all beneficial uses, including public health and public enjoyment; the propagation, protection, and restoration of fish, shellfish, wildlife, and their habitats; and the protection of the surface waters of the Lummi Indian Reservation as cultural, economic, and spiritual resources of the Lummi People.
3. Identify and evaluate on- and off-Reservation sources of fecal coliform bacteria contributions to shellfish harvest areas.
4. Detect and document threats to water quality and associated beneficial uses to support compliance actions.
5. Protect ground water supplies from saltwater intrusion and ground water mining.

3.3. Surface Water Quality Monitoring Program Objectives

The Lummi Nation Nonpoint Source Assessment Report (LWRD 2001), the Lummi Nation Nonpoint Source Management Plan (LWRD 2002), and other documents developed as part of the Lummi Nation Comprehensive Water Resources Management Program (LWRD 1997, LWRD 1998, LWRD 2000) identify and locate the numerous threats to the quality of Lummi Nation Waters. These threats include both point and nonpoint sources of pollution associated with various land uses.

The purpose of the surface water quality monitoring component of the Program is to establish the baseline conditions of waters on and flowing onto the Reservation, to detect water quality problems, and to help identify the pollutant sources. Information from the Program is used to:

- Evaluate compliance of waters flowing onto and within the Reservation with water quality criteria,
- Evaluate fecal coliform bacteria contributions from on- and off-Reservation to shellfish harvest areas, and
- Support the development and implementation of a water quality regulatory program on the Reservation, including the creation, adoption, implementation, and revision of Lummi Nation Water Quality Standards.

3.4. Ground Water Quality Monitoring Program Objectives

The purpose of the ground water quality monitoring component of the Program is to protect ground water supplies from saltwater intrusion and ground water mining. Ground water resources on the Reservation are vulnerable to salt water intrusion due to the proximity of marine waters and local geology (LWRD 1997). The majority of residential development to date has occurred along the marine shorelines of the Reservation placing the most vulnerable portion of aquifers at risk through direct pumping of ground water near marine waters.

Protection of ground water is essential because:

- Over 95 percent of all water consumed on the Reservation comes from ground water.
- An ample supply of good quality ground water is needed to serve the purposes of the Reservation as a permanent and economically viable homeland for the Lummi People.

4. SURFACE AND GROUND WATER QUALITY ASSESSMENT METHODS

The purpose of this section of the report is to summarize the approach used to establish the ambient quality conditions of Reservation surface and ground water and to summarize the field data collection and laboratory analysis methodologies detailed in the *Lummi Nation Water Quality Monitoring Program Quality Assurance/Quality Control Plan – Version 4.0* (LWRD 2010b).

4.1. Overview of Surface and Ground Water Assessment Design

The LWRD employs both a fixed station network and a targeted water sampling design. The fixed station network is used for baseline water quality monitoring and includes 43 routine surface water sample sites and 28 ground water sample sites (LWRD 2010b). In addition to these 43 surface water quality sample sites, the LWRD also collects samples at six Washington Department of Health (DOH) sample sites within Lummi Bay. As described in Section 4.2, the DOH collects water quality samples from Portage Bay. A targeted sampling design approach is used to improve understanding of specific issues that warrant further investigation (e.g., a reported or observed manure spill, a fish or waterfowl kill near a pesticide application site, questions regarding water quality impacts of an automobile recycling facility, storm water discharge from a construction site). For a targeted design approach, sites from the fixed station monitoring network and other sites generally located both up and downstream from the identified potential pollutant source are sampled.

4.2. Surface Water Field Data Collection and Laboratory Analysis

Since 1993, the Program has grown significantly in the number of sites sampled, the parameters measured, and the ability to manage and analyze collected data. Additional sites were added in the late 1990s to better evaluate the water quality impacts of Nooksack River water on Portage Bay and to better evaluate conditions in the Lummi Bay watershed. Figure 4.1 shows the locations of the current LWRD water quality sampling sites on the Reservation and the DOH sample sites in Portage Bay. Many of the 43 sample sites are located along the Reservation border, with the majority of the contributing watershed located off-Reservation. Several intermittent streams and storm water systems are sampled as part of the Program, along with the marine waters of Lummi Bay, Portage Bay, and the Sandy Point Marina.

In consultation with the Lummi Nation and under the Shellfish Consent Decree (Order Regarding Shellfish Sanitation, *United States v. Washington [Shellfish]*, Civil Number 9213, Subproceeding 89-3, Western District of Washington, 1994), the Washington Department of Health (DOH) is responsible to the federal Food and Drug Administration (FDA) to ensure that the National Shellfish Sanitation Program (NSSP) standards for certification of shellfish

growing waters are met on the Reservation. In Lummi Bay six sites are sampled to provide logistical assistance to the DOH and also to assist with the achievement of Program goals. The DOH samples 12 sites in Portage Bay six times a year, which also assists in achievement of the Program goals.

Thirty-two (32) of the 43 Lummi sampling sites are accessible from land. As summarized in Table 4.1 and Table 4.2, the LWRD staff measure a range of water quality variables each month. During the late summer to early-winter period, “first flush” sampling is conducted at many of these sample sites at variable intervals (daily to weekly) based upon precipitation and runoff levels during the onset of the wet season.

The remaining 11 surface water quality sample sites are accessible by boat and are located on Portage Island, in southern Portage Bay, in Lummi Bay, and in the Sandy Point Marina. These sample sites are targeted for monthly sampling, but unsafe weather conditions have historically reduced the sampling frequency. A larger sampling boat was put into service during 2007 to allow for safe sampling during poor weather conditions. The DOH sites in northern Lummi Bay are sampled at least six times each year by LWRD staff in coordination with the DOH.

Information from all sample runs is used to establish baseline conditions, identify trends, and to evaluate compliance with water quality criteria. Some runs serve other purposes as well, for example, to determine if sources of fecal coliform bacteria in Portage Bay are local or from the Nooksack River watershed. To make this determination, the data collected by the DOH in and around Portage Bay are analyzed in conjunction with the data collected as part of the “Lummi Shore Road” (LSR) sample run and the “Portage Bay DOH Support” sample run. The LSR sample run is scheduled to occur within a few hours prior to the DOH sampling of Portage Bay. At the latest, the sampling occurs concurrently with DOH sampling of Portage Bay. Similar to the LSR sample run, the data collected as part of the “Bellingham Bay Watershed First Flush” sample run aid in determining fecal coliform bacteria sources impacting the Portage Bay shellfish beds.

The data collected during the “Floodplain East” (FPE) and “Floodplain West” (FPW) sample runs are used to establish baseline conditions for waters flowing onto the Reservation and waters contributing to Lummi Bay (all within the Lummi Reservation). Similar to the LSR sample run, the data collected as part of the FPE, FPW, and Lummi Bay First Flush sample runs aid in determining fecal coliform bacteria sources that may affect the Lummi Bay shellfish beds.

The collection of water quality data along the Reservation boundary allows for compliance evaluation of waters flowing onto the Reservation by comparing the sample results with water quality criteria. The sample site selection also allows surface water quality to be evaluated along the length of the Lummi River floodplain water bodies and their tributaries. This water quality information is used to help identify pollution sources in the Lummi Bay Watershed.



Figure 4.1 Lummi Surface Water Quality Sampling Sites and DOH Sample Sites

Data collected as part of the boat accessible sample run are used to establish baseline conditions of water quality in the Sandy Point Marina, Lummi Bay, Portage Bay, and the five Portage Island fresh water discharges to Portage Bay. These data can also help identify sources of pollution.

The Lummi Bay DOH Support sample run is conducted to provide information about water quality in the northern portion of Lummi Bay and assists in evaluating downstream impacts of elevated fecal coliform bacteria levels measured along the Reservation boundary.

The primary change in parameters measured over the Program period of record was the addition of new laboratory analyses. Bacteria sampling expanded in 2000 from often enumerating only one type of bacteria, fecal coliform or *Escherichia coli* (*E. coli*), to consistently enumerating both of these bacteria plus enterococci. In addition, starting in 1999 a suite of nutrient samples was collected approximately four times per year at five sites, and metals are sampled four times per year at two sites. When the Program was initiated in 1993, no nutrient or metal analyses were performed. At selected sites, discharge is measured to allow for loading calculations, and sampling is increased from the regular once-per-month to more frequent sampling during “first flush” events.

The conventional parameters measured over the Program period of record have remained constant, with the exception of pH and turbidity. The pH was not measured for many years (except at the contract laboratory for nutrient and metal samples) and, although total suspended solids are measured at the five sites that are sampled for nutrients, turbidity was not measured consistently prior to 2008. These parameters were not measured because of equipment problems coupled with the staff constraints described in Section 1.2. Starting in 2007, pH analysis was included for all sampling events, even if in some cases pH results were not obtained because of equipment malfunctions. Since March 2008, monthly turbidity measurements have been collected at the sample sites. Flow was not measured regularly at each site during 2010 due to time constraints.

Table 4.1 summarizes the surface water quality monitoring sampling schedule for the following parameters measured during 2010 (see Appendix A): water temperature, air temperature, water depth, specific conductivity, salinity, dissolved oxygen, pH, fecal coliform bacteria, *E. coli*, and enterococci. In accordance with the quality assurance plan for the laboratory, the contracted independent laboratory measures all bacteria from the same sample bottle, and fecal coliform bacteria and *E. coli* are measured from the same culture.

Table 4.2 shows the specific nutrients, metals, and hydrocarbons analyzed at independent state or federally certified laboratories. Due to the costs of analyzing water quality samples for metals and petroleum hydrocarbons, these parameters are only measured quarterly at two of the water quality monitoring sites (one fresh water site downstream from a petroleum oil refinery and one marine water site within a recreational boat marina). Similarly, due to cost considerations, nutrients are measured quarterly at only five of the surface water quality monitoring sites. Depending on the specific intent of the sampling effort, nutrients analyzed range from ammonia, nitrate, and total phosphorus for “first flush” sample runs during the onset of the rainy season, to the same five parameters plus 5-day biochemical oxygen

demand (BOD), nitrite, Total Kjeldahl Nitrogen (TKN), orthophosphate, total organic carbon, total suspended solids, total volatile suspended solids, alkalinity, pH, sulfate, sulfide, chlorophyll *a*, iron, and silicon. Metals analyzed include lead, zinc, copper, and chromium at Site SW001 and Site SW014. The Site SW001 location is near the Sandy Point Marina and the Site SW014 location is along the stream that drains from the ConocoPhillips petroleum oil refinery located along the western extent of the northern Reservation boundary. At both of these sites, pH and petroleum hydrocarbons are also measured. During the 2010 sampling season, due to time and resource constraints each nutrient and metal sample site was sampled once, except sample Site SW015, which was sampled twice.

The major change in data collection during 2010 was the addition of continuous water temperature dataloggers at 10 surface water quality sites throughout the Reservation starting in January 2010. Water temperature is measured continuously and the measured temperature averaged and recorded at 15 minute increments at each site. The water temperature data are downloaded on a monthly basis. The collected data are used to calculate the 7-day average of the daily maximum temperature for fresh water sites and the 1-day maximum temperature for marine water sites, which allows for a direct comparison with the applicable water quality standards. Due to lost equipment and inaccessible dataloggers, only six sites have a complete data set and one site has six months of data for 2010.

During the summer 2011, a comprehensive habitat characterization of all sample sites will be completed. Currently, the habitat at each site has been described in general terms in previous annual water quality summary reports. A more intensive evaluation of sample site habitat will assist in identifying locations on the Reservation that need restoration efforts to improve water quality.

The quality assurance protocols identified in the *Lummi Nation Water Quality Monitoring Program Quality Assurance/Quality Control Plan – Version 4.0* (LWRD 2010b) were followed for the sample collection in 2010. The quality assurance review strategy is anticipated to be completed by July 2011 and implemented for all future surface water data collected. The data collected during 2010 are provided in Appendix A and were exported to WQX on February 23, 2011.

Table 4.1 Surface Water Quality Monitoring Sites

Run Name	Sample Sites(s) Included	Conventional Parameters Measured At Each Sample Site	Laboratory Samples Collected At Each Sample Site	Measurement Frequency	Notes
Floodplain East (FPE)	15, 16, 17, 51, 52, 55, 56, 59, 72, 118	Air temperature, salinity-based stratification, water temp., salinity, specific conductivity, current/flow direction, dissolved oxygen (DO), flow, pH, water/level depth, turbidity, and general observations	Fecal coliforms, <i>E. coli</i> , and enterococcus	Monthly	Site 118 along the Nooksack River is measured in all surface water sample runs, providing information on a known pollutant source to Portage Bay. Site 51 is measured in both the FPE and FPW runs. Flow is only measured when appropriate channel conditions are present.
Floodplain West (FPW)	3, 8, 9, 10, 11, 12, 13, 14, 51, 53, 58, 118	Air temperature, salinity-based stratification, water temp., salinity, specific conductivity, current/flow direction, DO, flow, pH, water/level depth, turbidity, and general observations	Fecal coliforms, <i>E. coli</i> , and enterococcus	Monthly	Site 118 along the Nooksack River is measured in all surface water sample runs, providing information on a known pollutant source to Portage Bay. Site 51 is measured in both the FPE and FPW runs. Flow is only measured when appropriate channel conditions are present.
Lummi Shore Road (LSR)	7, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 118	Air temperature, salinity-based stratification, water temp., salinity, specific conductivity, current/flow direction, DO, flow, pH, water/level depth, turbidity, and general observations	Fecal coliforms, <i>E. coli</i> , and enterococcus	Monthly in coordination with the DOH sampling of Portage Bay Sites along Lummi Shore sampled from north to south or from south to north	Occasionally Site 118 is sampled at beginning and end of run if Portage Bay sampling occurs late in the morning or afternoon. Flow is only measured at upland sites along the Portage and Bellingham Bay shorelines.

Table 4.1 Surface Water Quality Monitoring Sites

Run Name	Sample Sites(s) Included	Conventional Parameters Measured At Each Sample Site	Laboratory Samples Collected At Each Sample Site	Measurement Frequency	Notes
Marine Boat-Accessible (Marine)	1, 2, 6, 19, 22, 23, 24, 25, 26, 27, 28	Salinity-based stratification, water temp., salinity, specific conductivity, current/flow direction, dissolved oxygen (DO), flow, pH, Secchi depth, water/level depth, turbidity, and general observations	Fecal coliforms, <i>E. coli</i> , and enterococcus	Monthly, as needed	Measure flow at the Portage Island sites (sites numbered 24 through 28) when channel and flow conditions are appropriate.
Lummi Bay DOH Support	DOH 285, DOH 286, DOH 287, DOH 288, DOH 38, DOH 39, DOH 40, DOH 41, DOH 42, DOH 43, DOH 44, DOH 45	Salinity-based stratification, water temp., salinity, specific conductivity, current/flow direction, DO, flow, pH, Secchi depth, water level/depth, turbidity, and general observations	Fecal coliforms	Six times annually	Washington Department of Health (DOH) provides sample bottles and bacteria enumeration. Logistical difficulties prevent DOH staff from sampling Lummi Bay: tidal window for access to marine sample sites in Portage and Lummi bays is narrow, particularly in the summer (+8.5ft MLLW tide minimum is required). LNR staff collects bacteria samples and measures other water quality for comparison with water quality standards.
Portage Bay DOH Support	118	Air temperature, salinity-based stratification, water temp., salinity, specific cond., current/flow direction, DO, pH, water level/depth, turbidity, and general observations	Fecal coliforms, <i>E. coli</i> , and enterococcus	Three times in one day the day before LSR sample run and DOH sampling of Portage Bay	

Table 4.1 Surface Water Quality Monitoring Sites

Run Name	Sample Sites(s) Included	Conventional Parameters Measured At Each Sample Site	Laboratory Samples Collected At Each Sample Site	Measurement Frequency	Notes
Lummi Bay Watershed First Flush	11, 10, 12, 13, 9, 58, 8, 3, 53, 51, 118 Time permitting: 14, 59, 15, 16, and 17	Salinity-based stratification, water temperature, salinity, specific conductivity, current/flow direction, dissolved oxygen (DO), flow, pH, water level/depth, turbidity, and general observations	Fecal coliforms, <i>E. coli</i> , and enterococcus	As needed based upon predicted and observed runoff during the onset of the rainy season	Site 118 along the Nooksack River is measured in all surface water sample runs, providing information on a known pollutant source to Portage Bay. Site 51 is measured in both the FPE and FPW runs. Flow is only measured when appropriate channel conditions are present.
Bellingham Bay Watershed First Flush	7, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 118	Salinity-based stratification, water temperature, salinity, specific conductivity, current/flow direction, dissolved oxygen (DO), flow, pH, water level/depth, turbidity, and general observations	Fecal coliforms, <i>E. coli</i> , and enterococcus	The day following the Lummi Bay First Flush sample run	Sites along Lummi Shore Road sampled from north to south or from south to north. Flow is only measured at upland sites along the Portage Bay and Bellingham Bay shorelines. Site 29 samples a relatively undeveloped Lummi Peninsula upland watershed and is used as a control site representing a watershed that is minimally affected by development.

Table 4.2 Parameters Measured Quarterly at Selected Sites

Sample Site Number(s)	Group Name	Parameters	Frequency of Collection	Notes
1	Hydrocarbons	Diesel and Lube Oil range hydrocarbons	Quarterly, (depending on the year)	Sample collected in 1-L glass amber bottle. (Monday through Thursday only)
	Metals	Arsenic, Copper, Mercury, Tin, Zinc, Hardness, and pH with the temperature of the water sample at the time of measurement	Quarterly, depending on the year	Sample collected in 1-L plastic bottle. (Monday through Thursday only)
2, 3, 6, 9, 15	Nutrients	Alkalinity, Ammonia, Biochemical Oxygen Demand, Nitrate-N, Nitrite-N, Total Kjeldahl Nitrogen, Ortho Phosphate, Total Phosphorus, pH [with temperature at time of reading], Total Organic Carbon, Total Suspended Solids, Total Volatile Suspended Solids, and may include Iron, Sulfate, Chlorophyll a, Sulfide, Silicon and Chemical Oxygen Demand	Quarterly, (depending on the year)	Samples collected in 3 1-L plastic bottles (4 1-L plastic bottles for marine samples) and 2 40-mL amber vials with a preservative. Nitrite and Nitrate are normally combined. (Monday through Thursday only)
14	Hydrocarbons	Diesel and Lube Oil range hydrocarbons	Quarterly and First Flush (depending on the year)	Sample collected in 1-L glass amber bottle. (Monday through Thursday only)
	Metals	Chromium, Copper, Lead, Zinc, Hardness and pH with the temperature of the water sample at the time of measurement	Quarterly and First Flush (depending on the year)	Sample collected in 1-L plastic bottle. (Monday through Thursday only)

4.3. Ground Water Field Data Collection

Twenty-eight ground water sample sites (Figure 4.2) were selected for regular monitoring to characterize the two major potable aquifer systems on the Reservation. Table 4.3 lists the well sampling groups, wells in each group, well number, parameters measured, and measurement frequency. The number of wells sampled has increased over the years but the parameters measured have not changed, other than the addition of pH and salinity measurement. Wells were added to the Program as they were drilled or when access was granted to obtain better spatial resolution of aquifer conditions. Water level, pumping status, temperature, specific conductivity, pH, salinity, and chloride concentration are measured monthly or more frequently at each site. Well production is recorded from existing meters at the Lummi Water District water supply wells. If a well is not sampled when scheduled, the well is sampled as soon as possible afterwards.

Sample sites were selected to represent aquifer-wide conditions as practicable, but the spatial representativeness of these sampling points is limited by the lack of existing ground water wells in some parts of the Reservation – particularly along the interior of the Lummi Peninsula and the eastern part of the northwestern upland.

The primary sources of variability are seasonal changes (i.e., wet season and dry season) and pumping regimes (which are typically related to season). This variability is addressed through frequent sampling (sub-monthly to monthly), performing multiple well water level measurements during sampling at each well, and recording the pumping rate, totalizer values (if metered), and pump status of the well at the time of measurement. Water quality is generally stable in the wells.

The chloride concentration, pumping rate and amounts, and water levels of the water supply wells provide critical information about aquifer condition, pumping regimes, and the need for protective measures as these data indicate whether seawater intrusion is occurring or if the likelihood of seawater intrusion has increased. For wells that are not used for water supply purposes (e.g., inactive wells), water level provides information about aquifer conditions.

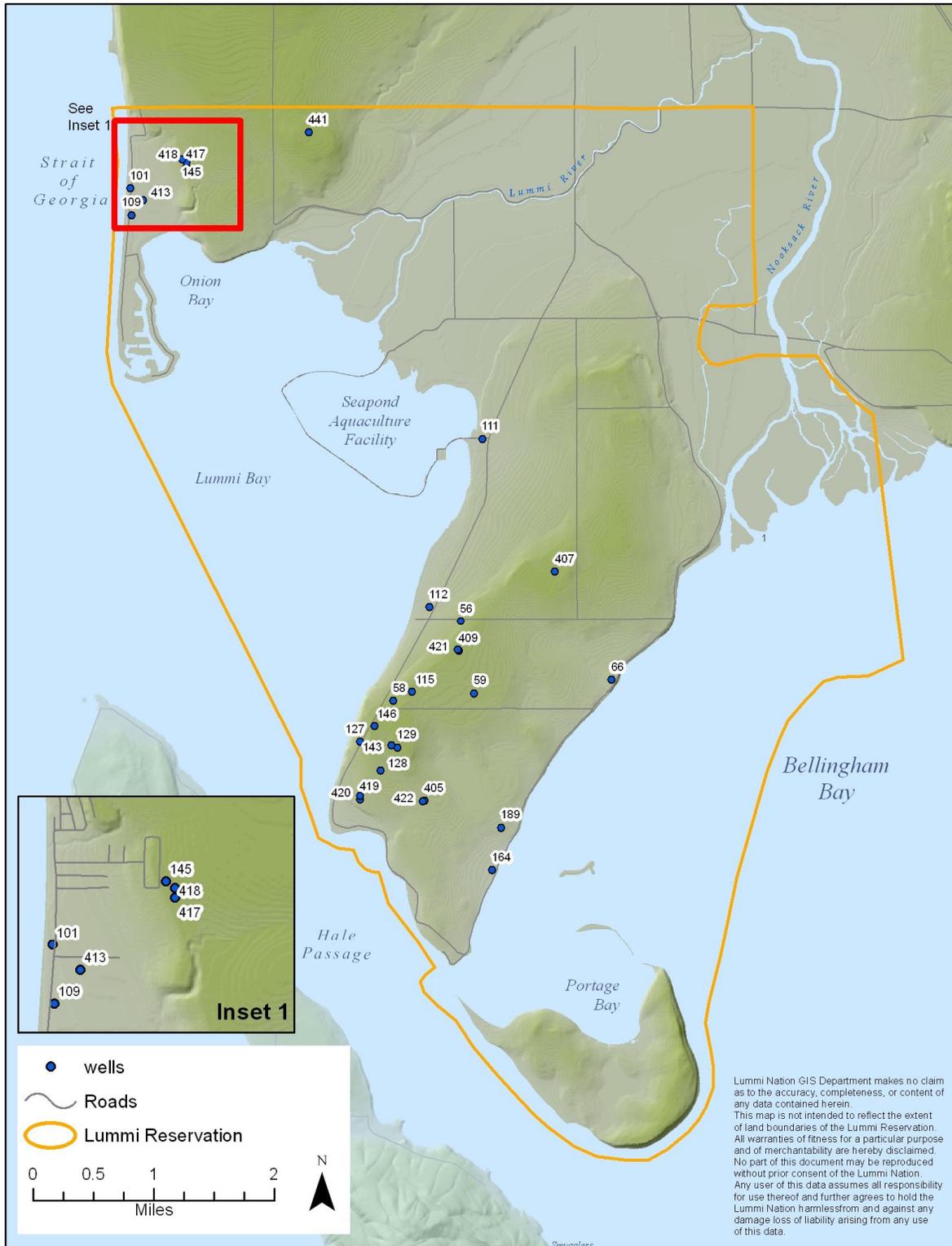


Figure 4.2 Ground Water Quality Monitoring Sample Sites

Table 4.3 Ground Water Quality Monitoring Wells

Well Group	Wells	Well Number	Parameters Measured At Each Sample Site	Measurement Frequency
Domestic	R. Jefferson	112	Water level	Monthly
	K. Charles	74	Water level, chloride, temperature, specific conductivity, pH, salinity	Monthly
	Berg	143	Water level, chloride, temperature, specific conductivity, pH, salinity	Monthly
	Bewley	164	Water level	Monthly
	M. Egawa	189	Water level, chloride, temperature, specific conductivity, pH, salinity	Monthly
	J. Finkbonner	109	Chloride, temperature, specific conductivity, pH, salinity, water level infrequently	Monthly
	T. Teeter	413	Water level, chloride, temperature, specific conductivity, pH, salinity	Monthly
	Skolrood	101	Water level, chloride, temperature, specific conductivity, pH, salinity	Monthly
Potable Public Water Supply Wells	Balch	115	Water level, water use, chloride, temperature, specific conductivity, pH, salinity	Monthly, or more as needed
	Horizon	58	Water level, water use, chloride, temperature, specific conductivity, pH, salinity	Monthly, or more as needed
	Kinley Way (Kinley 1)	59	Water level, water use, chloride, temperature, specific conductivity, pH, salinity	Monthly, or more as needed
	Kinley 2	409	Water level, water use, chloride, temperature, specific conductivity, pH, salinity	Monthly, or more as needed
	Kinley 3	421	Water level, water use, chloride, temperature, specific conductivity, pH, salinity	Monthly, or more as needed
	Mackenzie 2	129	Water level, water use, chloride, temperature, specific conductivity, pH, salinity	Monthly, or more as needed
	Northwest Well 2 (NW2)	418	Water level, water use, chloride, temperature, specific conductivity, pH, salinity	Monthly, or more as needed
	West Shore	146	Water level, water use, chloride, temperature, specific conductivity, pH, salinity	Monthly, or more as needed
	Gooseberry Point 4	420	Water level, water use, chloride, temperature, specific conductivity, pH, salinity	Monthly, or more as needed
	Gooseberry Point 5	419	Water level, water use, chloride, temperature, specific conductivity, pH, salinity	Monthly, or more as needed

Table 4.3 Ground Water Quality Monitoring Wells

Well Group	Wells	Well Number	Parameters Measured At Each Sample Site	Measurement Frequency
Monitoring Wells	Hopkins	111	Water level, datalogger upload	Monthly
	Cultee	56	Water level, datalogger upload	Monthly
	Revey	127	Water level, datalogger upload	Monthly
	Mackenzie 1	128	Water level, datalogger upload	Monthly
	Mackenzie 3	405	Water level, datalogger upload	Monthly
	Mackenzie 4	422	Water level	Monthly
	Pierre	66	Water level, datalogger upload	Monthly
	Northwest Well 1 (NW1)	417	Water level, datalogger upload	Monthly
Other Wells	Johnson	145	Water level, datalogger upload, water use, chloride, temperature, specific conductivity, pH, salinity, tank level, and discharge from manifold in tank Flow rate and totalizer at all meters except M. Finkbonner (Nau) and Greg Finkbonner meters every visit to Johnson well. The latter two meters are measured monthly	Weekly or more frequently for water quality, water level, and water use
	Northwest Well 3 (NW3)	441	Water use, chloride, temperature, specific conductivity, pH, salinity	Monthly, or more as needed

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5. LUMMI NATION SURFACE WATER QUALITY STANDARDS

The purpose of this section of the report is to summarize the Lummi Nation Surface Water Quality Standards (LWRD 2008a). The Water Quality Standards (WQS) for Surface Waters of the Lummi Indian Reservation were adopted by the Lummi Nation in August 2007 and approved by the EPA on September 30, 2008. The standards are summarized in Table 5.1. Figure 5.1 shows the surface waters of the Lummi Nation, water body classifications for the surface waters, and the current sampling locations.

Because of the Reservation location in the Nooksack River and Lummi River estuaries, many Reservation water bodies are seasonally brackish. This temporal and spatial variability creates uncertainty regarding whether or not marine or fresh water standards apply. To remove this uncertainty, the approach taken in developing the water quality standards for the surface waters of the Reservation was to identify specific geographic locations as the demarcation between fresh and marine waters. These locations are depicted in Figure 5.1. A line between Fish Point and Treaty Rock separates fresh water and marine water in the Nooksack River Delta. The location where the water body flows under Hillaire Road separates the fresh water and marine water in the Lummi River Delta, which corresponds with sample site SW008 shown on Figure 5.1.

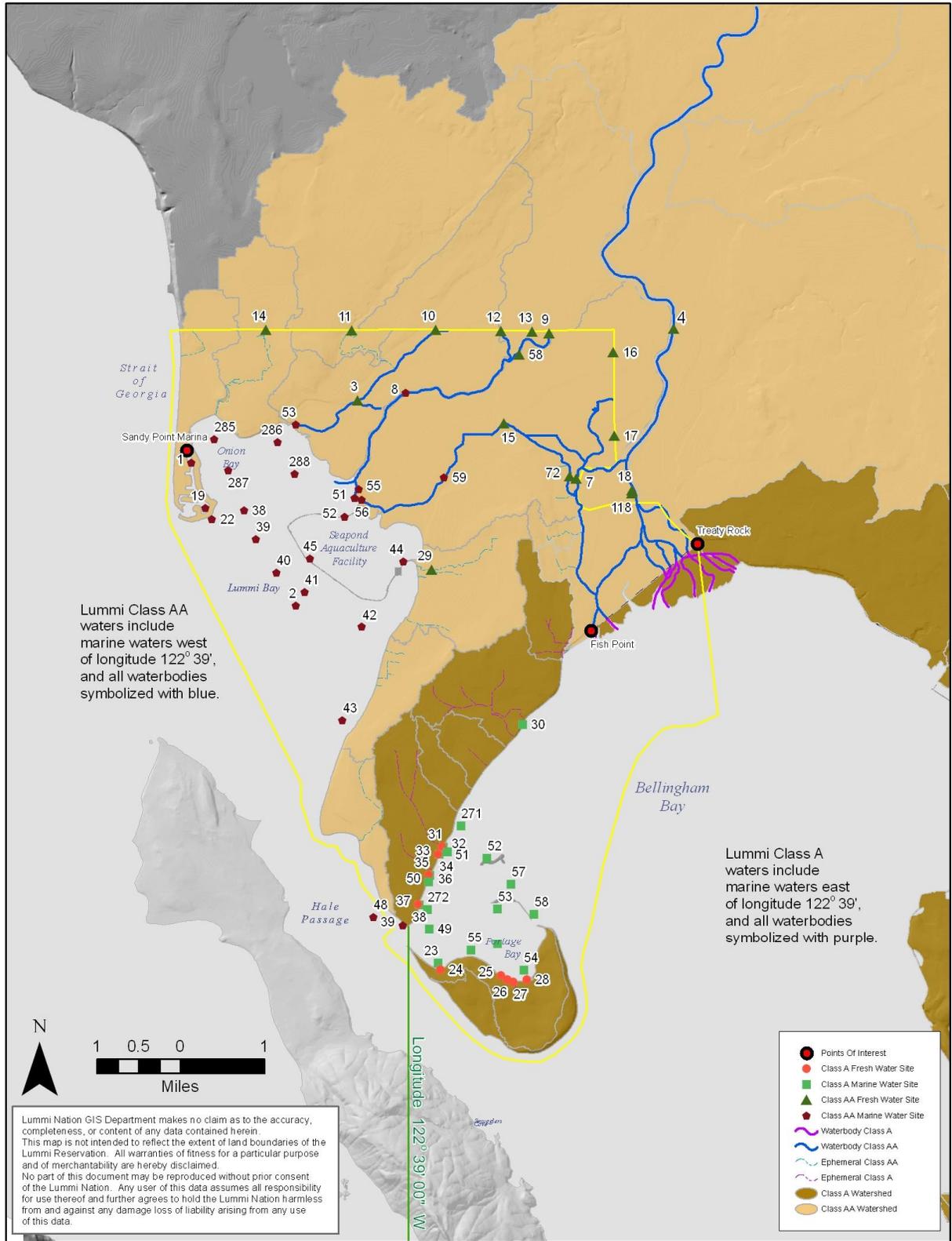


Figure 5.1 Classification of Lummi Nation Waters and Current Sampling Locations

Table 5.1 Summary of Water Quality Criteria and Uses of the Various Classes of Lummi Indian Reservation Surface Waters

Parameter	Surface Water Classes of the Lummi Indian Reservation			
	Class AA Extraordinary	Class A Excellent	Class B Good	Lake Class
General Characteristics	Uniformly exceeds the requirements for all or substantially all uses	Meets or exceeds the requirements for all or substantially all uses	Meets or exceeds the requirements for most uses	Meets or exceeds the requirements for all or substantially all uses

Table 5.1 Summary of Water Quality Criteria and Uses of the Various Classes of Lummi Indian Reservation Surface Waters

Parameter	Surface Water Classes of the Lummi Indian Reservation			
	Class AA Extraordinary	Class A Excellent	Class B Good	Lake Class
Characteristic Uses	<p>(A) Water supply (domestic, commercial, municipal, industrial, agricultural).</p> <p>(B) Stock watering.</p> <p>(C) Fish and shellfish: Salmonid migration, juvenile rearing, spawning, egg incubation, fry emergence, and harvesting. Other fish migration, juvenile rearing, spawning, egg incubation, fry emergence, and harvesting. Clam, oyster, and mussel rearing, and harvesting. Crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, geoduck, etc.) rearing, spawning, and harvesting.</p> <p>(D) Wildlife habitat.</p> <p>(E) Recreation (extraordinary primary contact, primary contact, sport fishing, boating, canoeing, and aesthetic enjoyment).</p> <p>(F) Commerce and navigation.</p> <p>(G) Tribal Cultural</p>	<p>(A) Water supply (domestic, commercial, municipal, industrial, agricultural).</p> <p>(B) Stock watering.</p> <p>(C) Fish and shellfish: Salmonid migration, juvenile rearing, and harvesting. Other fish migration, juvenile rearing, spawning, egg incubation, fry emergence, and harvesting. Clam, oyster, and mussel rearing, and harvesting. Crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, geoduck, etc.) rearing and spawning.</p> <p>(D) Wildlife habitat.</p> <p>(E) Recreation (secondary contact, sport fishing, boating, and aesthetic enjoyment).</p> <p>(F) Commerce and navigation.</p> <p>(G) Tribal Cultural</p>	<p>(A) Water supply (domestic, commercial, municipal, industrial, agricultural).</p> <p>(B) Stock watering.</p> <p>(C) Fish and shellfish: Salmonid migration, juvenile rearing, spawning, egg incubation, fry emergence, and harvesting. Other fish migration, juvenile rearing, spawning, egg incubation, fry emergence, and harvesting. Clam, oyster, and mussel rearing, and harvesting. Crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, geoduck, etc.) rearing and spawning.</p> <p>(D) Wildlife habitat.</p> <p>(E) Recreation (secondary contact, sport fishing, boating, and aesthetic enjoyment).</p> <p>(F) Commerce and navigation.</p> <p>(G) Tribal Cultural</p>	<p>(A) Water supply (domestic, commercial, municipal, industrial, agricultural).</p> <p>(B) Stock watering.</p> <p>(C) Fish and shellfish: Salmonid migration, juvenile rearing, spawning, egg incubation, fry emergence, and harvesting. Other fish migration, juvenile rearing, spawning, egg incubation, fry emergence, and harvesting. Clam, oyster, and mussel rearing, and harvesting. Crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, geoduck, etc.) rearing and spawning. Crayfish rearing and spawning.</p> <p>(D) Wildlife habitat.</p> <p>(E) Recreation (extraordinary primary contact, primary contact, sport fishing, boating, canoeing, and aesthetic enjoyment).</p> <p>(F) Commerce and navigation.</p> <p>(G) Tribal Cultural</p>

Table 5.1 Summary of Water Quality Criteria and Uses of the Various Classes of Lummi Indian Reservation Surface Waters

Parameter	Surface Water Classes of the Lummi Indian Reservation			
	Class AA Extraordinary	Class A Excellent	Class B Good	Lake Class
Fresh Water Fecal Coliform Bacteria Geometric Mean Density	Shall both not exceed 50 colonies/100 ml AND not exceed 100 colonies/100 ml in more than 10% of the samples obtained for calculation purposes	Shall both not exceed 100 colonies/100 ml AND not exceed 200 colonies/100 ml in more than 10% of the samples obtained for calculation purposes	Shall both not exceed 200 colonies/100 ml AND not exceed 400 colonies/100 ml in more than 10% of the samples obtained for calculation purposes	Shall both not exceed 50 colonies/100 ml AND not exceed 100 colonies/100 ml in more than 10% of the samples obtained for calculation purposes
Marine Water Fecal Coliform Bacteria Geometric Mean Density	Shall both not exceed 14 colonies/100 ml AND not exceed 43 colonies/100 ml in more than 10% of the samples obtained for calculation purposes	Shall both not exceed 14 colonies/100 ml AND not exceed 43 colonies/100 ml in more than 10% of the samples obtained for calculation purposes	Shall both not exceed 100 colonies/100 ml AND not exceed 200 colonies/100 ml in more than 10% of the samples obtained for calculation purposes	N/A
Fresh Water Enterococci	Shall both not exceed a geometric mean density of 33 colonies/100 ml AND not exceed a single sample maximum allowable density of 61 colonies/100 ml	Shall both not exceed a geometric mean density of 33 colonies/100 ml AND not exceed a single sample maximum allowable density of 61 colonies/100 ml	Shall both not exceed a geometric mean density of 33 colonies/100 ml AND not exceed a single sample maximum allowable density of 78 colonies/100 ml	Shall both not exceed a geometric mean density of 33 colonies/100 ml AND not exceed a single sample maximum allowable density of 61 colonies/100 ml
Marine Water Enterococci	Shall both not exceed a geometric mean density of 35 colonies/100 ml AND not exceed a single sample maximum allowable density of 104 colonies/100 ml	Shall both not exceed a geometric mean density of 35 colonies/100 ml AND not exceed a single sample maximum allowable density of 104 colonies/100 ml	Shall both not exceed a geometric mean density of 35 colonies/100 ml AND not exceed a single sample maximum allowable density of 158 colonies/100 ml	N/A

Table 5.1 Summary of Water Quality Criteria and Uses of the Various Classes of Lummi Indian Reservation Surface Waters

Parameter	Surface Water Classes of the Lummi Indian Reservation			Lake Class
	Class AA Extraordinary	Class A Excellent	Class B Good	
Fresh Water Dissolved Oxygen Concentration	The seven-day mean minimum shall both not be less than 11.0 mg/l AND not have a spatial median intergravel dissolved oxygen concentration below 8.0 mg/l. If minimum spatial median intergravel dissolved, oxygen is 8.0 mg/l or greater, the minimum dissolved oxygen criterion is 9.0 mg/l.	Shall not be less than 8.0 mg/l.	Shall not be less than 6.5 mg/l.	No measurable decrease from natural conditions
Marine Water Dissolved Oxygen Concentration	Where barometric pressure and temperature preclude attainment of criteria, dissolved oxygen must not be less than 95% of saturation. Shall exceed a 1-day minimum daily concentration of 7.0 mg/l	Where barometric pressure and temperature preclude attainment of criteria, dissolved oxygen must not be less than 90% of saturation. Shall exceed a 1-day minimum daily concentration of 6.0 mg/l		N/A
Fresh Water Temperature	Shall not exceed a 7-day average of the daily maximum value (7DADM) temperature of 16.0°C. For summertime spawning, temperature shall not exceed a 7DADM temperature of 13.0°C.	Shall not exceed a 7DADM temperature of 17.5°C.	Shall not exceed a 7DADM temperature of 17.5°C.	No measurable increase from natural conditions

Table 5.1 Summary of Water Quality Criteria and Uses of the Various Classes of Lummi Indian Reservation Surface Waters

Parameter	Surface Water Classes of the Lummi Indian Reservation			
	Class AA Extraordinary	Class A Excellent	Class B Good	Lake Class
Marine Water Temperature	Shall not exceed a 1-day maximum temperature of 13.0°C	Shall not exceed a 1-day maximum temperature of 16.0°C	Shall not exceed a 1-day maximum temperature of 19.0°C	N/A
Fresh Water pH	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5	No measurable change from natural conditions
Marine Water pH	7.0 – 8.5	7.0 – 8.5	7.0 – 8.5	N/A
Turbidity	Shall not exceed 5 NTU over background turbidity when background turbidity is less than or equal to 50 NTU OR not increase by more than 10% when the background turbidity is greater than 50 NTU	Shall not exceed 5 NTU over background turbidity when background turbidity is less than or equal to 50 NTU OR not increase by more than 10% when the background turbidity is greater than 50 NTU	Shall not exceed 5 NTU over background turbidity when background turbidity is less than or equal to 50 NTU OR not increase by more than 20% when the background turbidity is greater than 50 NTU	Shall not exceed 5 NTU over background turbidity
Toxic, Radioactive, Or Deleterious Material Concentrations	Shall be less than concentrations that have the potential either singularly or cumulatively to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health as determined by the Director.	Shall be less than concentrations that have the potential either singularly or cumulatively to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health as determined by the Director.	Shall be less than concentrations that have the potential either singularly or cumulatively to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health as determined by the Director.	Shall be less than concentrations that have the potential either singularly or cumulatively to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health as determined by the Director.

Table 5.1 Summary of Water Quality Criteria and Uses of the Various Classes of Lummi Indian Reservation Surface Waters

Parameter	Surface Water Classes of the Lummi Indian Reservation			
	Class AA Extraordinary	Class A Excellent	Class B Good	Lake Class
Aesthetic Values	Shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste or taint the flesh of edible species	Shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste or taint the flesh of edible species	Shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste or taint the flesh of edible species	Shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste or taint the flesh of edible species

6. SURFACE WATER QUALITY SAMPLE RESULTS AND REGULATORY COMPLIANCE

Water quality sample results for 2010 and water quality sample results for the period of record through 2009 at each site were compared with the applicable water quality standards associated with each sample site. The water quality standard values are depicted as horizontal lines in the graphs presented in this section of the report. For each sample site the maximum and minimum results are summarized as vertical bars. Sample site identification codes, corresponding to the sample site locations shown in Figure 4.1 and Figure 5.1 and listed in Table 4.1 and Table 4.2, are presented along the X-axis. The number of observations/sample results is shown just above the X-axis next to the respective bar. Turbidity results are depicted differently because turbidity water quality standards are expressed as relative to the background turbidity level, which is dependent on a number of factors including flow, time of year, and sediment load. The turbidity sample results are averaged to characterize the relative turbidity levels at each sample site. Although there are currently no applicable water quality standards, the sample results for total suspended solids (a measure of turbidity), phosphorus, and total nitrogen are also summarized.

The use of bar graphs to present the sample program results allows:

- The various sites within a specific water body classification to be compared to each other;
- The sample results to be compared with the applicable water quality standards;
- The sample results from 2010 to be compared with the sample results over the period of record through 2009.

However, the bar graphs do not allow for a presentation of seasonal variations or trends as the data are for the entire reporting period for the site rather than over time. In addition, because the bar graphs for water temperature, dissolved oxygen, and pH show the maximum and minimum of the measured values, a single measurement above or below a water quality criteria/threshold suggests that the standards are not achieved at the site even though a single sample result may be an anomaly.

To address these limitations, the bar graphs for the various parameters are supplemented with graphs from a representative sample site from the same water body classification to depict seasonal variations and trends over the period of record. Also, the continuous water temperature data from seven sites was used to calculate the 7-day average of the daily maximum for fresh water sample sites and the 1-day maximum temperature for marine water sample sites, which allows for a direct comparison with the applicable water quality standards and was used to depict the seasonal change in water temperature during 2010.

The selected representative fresh water sample sites are along the Lummi River and the Nooksack River. The continuous water temperature sites are along the Lummi River, Jordan Creek, Smuggler's Slough, and Schell Creek. The Lummi River and Nooksack River are the two largest fresh water bodies that discharge to marine waters on the Reservation. All of the

water bodies originate off-Reservation except Smuggler's Slough and are classified as Class AA waters. Because all of the Class A fresh water bodies are ephemeral streams that are seasonally dry, have low discharges when they have flow during the rainy season, and have been shown to have minimal or no measurable impact on the water quality of the receiving marine waters (LWRD 1999, LWRD 2006b, LWRD 2006c), a Class A fresh water body was not selected as a representative site or continuous water temperature monitoring site. As a result, the representative fresh water site associated with the Class A marine water site is a Class AA site located along the Nooksack River (Site SW018/SW118). The representative sample sites used to depict seasonal variations and trends are the following:

- Class AA Fresh Water: Site SW009 (Lummi River at Slater Road)
- Class AA Marine Water: Site SW002 (Lummi Bay)
- Class AA Fresh Water: Site SW118 (Nooksack River below Marine Drive – formerly Site SW018).
- Class A Marine water: Site SW030 (Bellingham Bay between the Nooksack River Delta and Portage Bay)

Sample Site SW018 was moved approximately 200 feet downstream along the west bank of the Nooksack River during 2008 to ensure safe access to the sampling location. The new sample site location was assigned the identifier Site SW118 but the samples at this site are from essentially the same water that was sampled at the discontinued Site SW018.

6.1. Fecal Coliform Bacteria Results

Bacteria sampling is routinely conducted at each of the surface water quality sampling locations. Pursuant to the *Lummi Nation Water Quality Monitoring Program Quality Assurance/Quality Control Plan – Version 4.0* (LWRD 2010b), the collected samples are transported on ice to a contracted analytical laboratory the day of collection and tested for fecal coliform bacteria, *E. coli*, and enterococcus. Water from one sample bottle is used for each of the tests, and fecal coliform bacteria and *E. coli* are enumerated from the same growth plates.

To allow comparison to the applicable water quality standards, the bar graphs for the bacteria types depict the geometric mean and 90th percentile for fecal coliform bacteria and *E. coli* and the geometric mean and maximum value for enterococcus bacteria for each site. As summarized in Table 5.1, the water quality standards for enterococcus bacteria set maximum bacteria counts. If sample results show a higher count than the applicable water quality standard, the water quality standard is not met and the characteristic uses of the water body are not supported.

6.1.1. Class AA Waters

The Class AA fresh water standards for fecal coliform bacteria are a geometric mean not to exceed 50 colony forming units (cfu) per 100 milliliters (ml) and a 90th percentile standard of 100 cfu/100 ml (from the values used to calculate the geometric mean). Although sample Site SW004 is shown in Figure 6.1 to have met this standard during 2010, these results reflect the laboratory findings from two samples. Site SW004 is a sample site along the Nooksack River at the Slater Road Bridge and is only sampled during flood conditions in the

Nooksack River because Site SW118 is inaccessible. Site SW118 (Nooksack River) achieved both the geometric mean and the 90th percentile water quality standard during 2010. As shown in Figure 6.1, the geometric mean was below the standard at 12 of the 16 sample sites during 2010. As shown in Figure 6.2, the geometric mean was below the standard at 8 of the 17 sites over the period of record. However, because the 90th percentile criterion was exceeded at all of the sites, the water quality standard for fecal coliform bacteria was not achieved at any of the Class AA fresh water sites for the period of record. The site with the highest geometric mean and 90th percentile during 2010 was Site SW011 along Jordan Creek at Slater Road (the northern Reservation boundary). Sample sites along the northern Reservation boundary (i.e., SW009, SW010, SW011, SW012, and SW014) have the highest fecal coliform bacteria geometric means and 90th percentiles. Sample Site SW003 is downstream from these sites along the boundary also experienced periodic high fecal coliform bacteria counts. All of these water bodies' discharge to Lummi Bay where important shellfish beds are located.

Site SW118 is located along the Nooksack River where it flows onto the Reservation. High bacteria densities at this site would represent a threat to the shellfish beds within and adjacent to Portage Bay and to the people who consume shellfish from these areas. The geometric mean for SW118, based on the most recent 30 sampling events during 2010, was 21 cfu/100 ml. This geometric mean is lower than the Lummi Nation fecal coliform bacteria geometric mean standard of 50 cfu/100 ml, and the Total Maximum Daily Load (TMDL) target of 39 cfu/100 ml established for the lower Nooksack River (Ecology 2000, 2002). The TMDL was established by the Washington Department of Ecology (Ecology) to be protective of the shellfish beds within and adjacent to Portage Bay and to protect the health of people who consume shellfish from these waters. The 90th percentile value at SW118, based on the most recent 30 samples collected at this site during 2010, was 82 cfu/100 ml, which meets the standard. Unlike the previous three years, the water quality standard at Site SW118 was achieved and the designated uses are supported.

The Class AA marine water quality standards for fecal coliform bacteria are more stringent than for Class AA fresh water and include a geometric mean not to exceed 14 cfu/100 ml and a 90th percentile (from the values used to calculate the geometric mean) standard of 43 cfu/100 ml. As shown in Figure 6.3, 17 of the 24 sample sites met these criteria during 2010. As shown in Figure 6.4, 15 of the 17 sites that met the criteria in 2010 also met the criteria for the period of record through 2009. Sample Site SW019 met the fecal coliform bacteria criteria for the period of record, it did not achieve the standard during 2010.

As shown in Figure 6.5, the fecal coliform bacteria sample results for the representative Class AA fresh water site that contributes to a Class AA marine water site (SW009 on the Lummi River along the northern Reservation boundary) have been consistently above the geometric mean and the 90th percentile criteria over the period of record. In contrast, as shown in Figure 6.6, the fecal coliform bacteria sample results for the representative Class AA marine water site (SW002 in Lummi Bay) have been consistently below the geometric mean and 90th percentile criteria over the period of record.

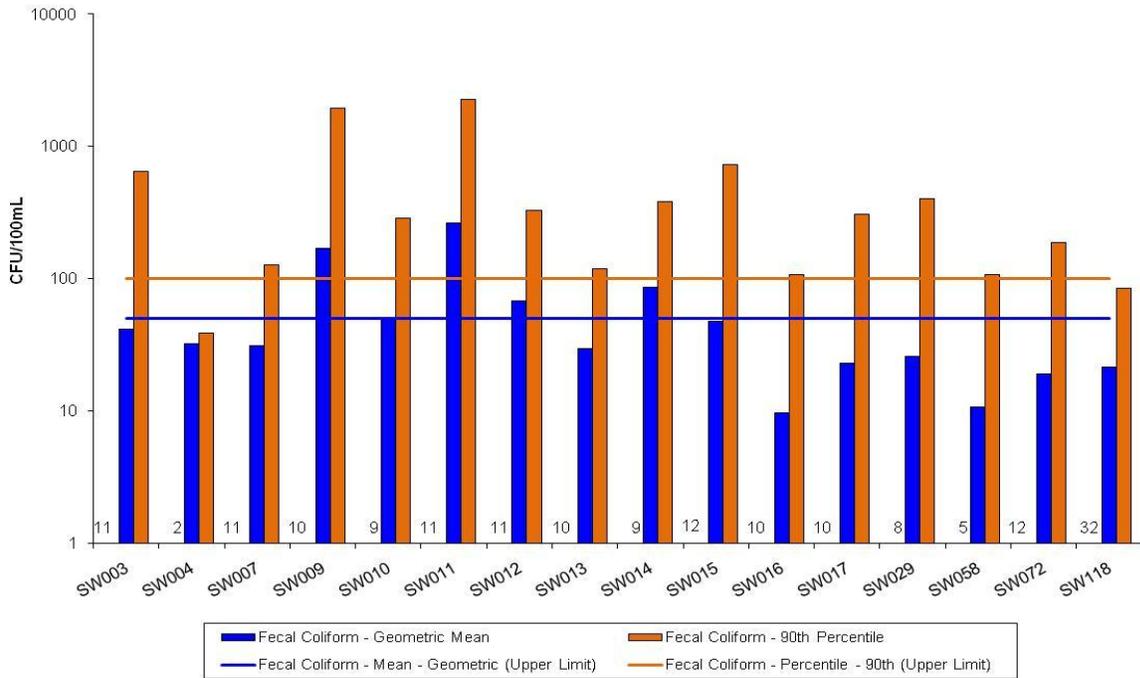


Figure 6.1 Class AA Fresh Water Fecal Coliform Bacteria Results Compared with Water Quality Standards: 2010

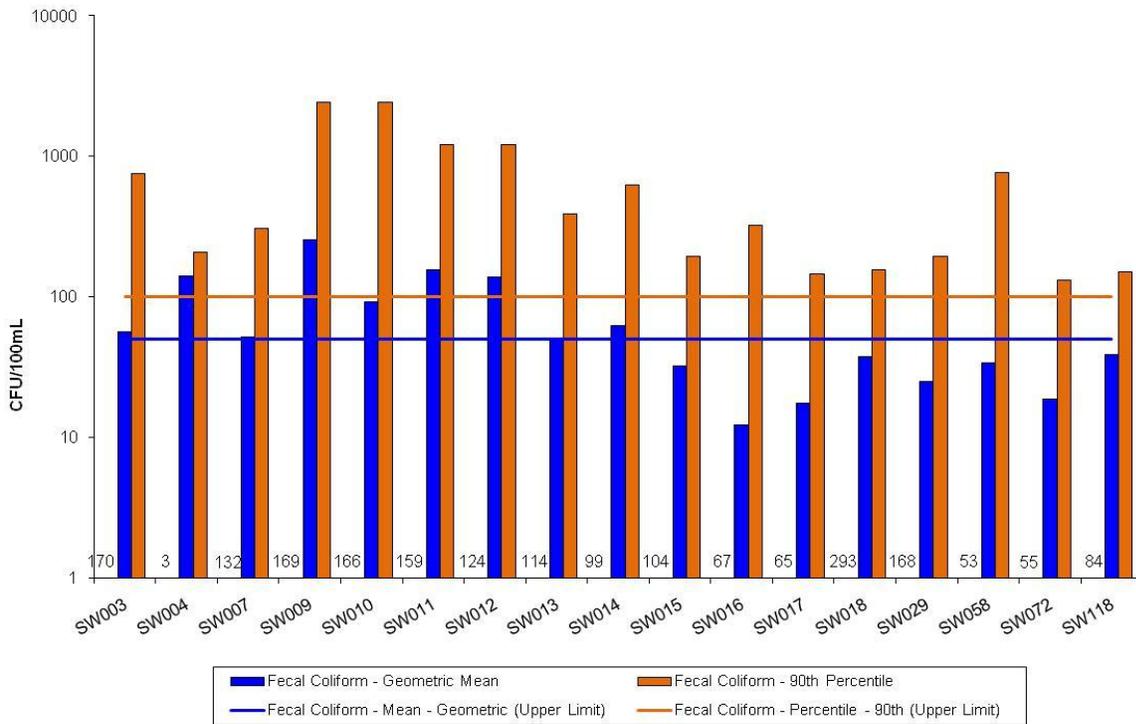


Figure 6.2 Class AA Fresh Water Fecal Coliform Bacteria Results Compared with Water Quality Standards: Period of Record through 2009

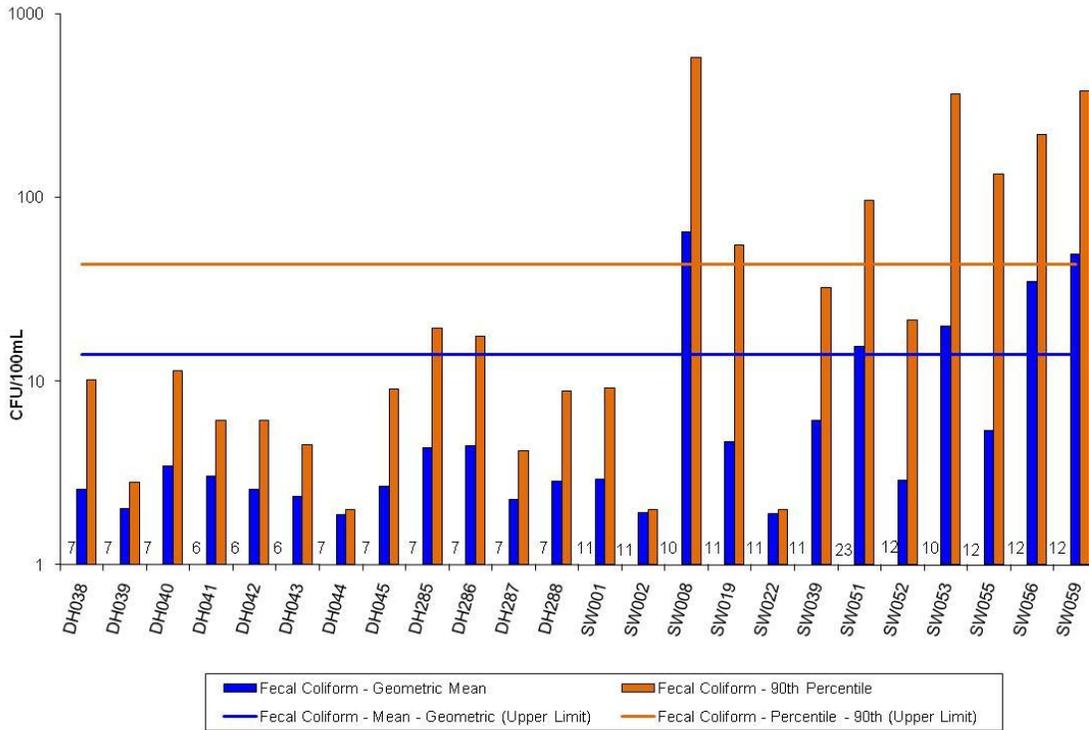


Figure 6.3 Class AA Marine Water Fecal Coliform Bacteria Results Compared with Water Quality Standards: 2010

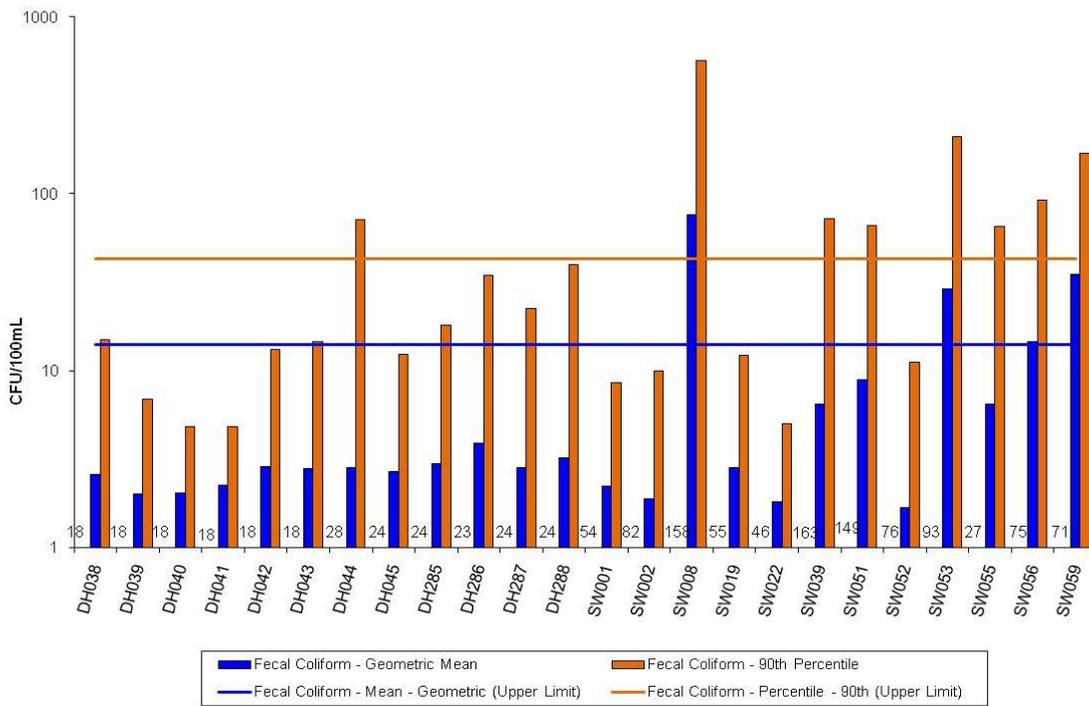


Figure 6.4 Class AA Marine Water Fecal Coliform Bacteria Results Compared with Water Quality Standards: Period of Record through 2009

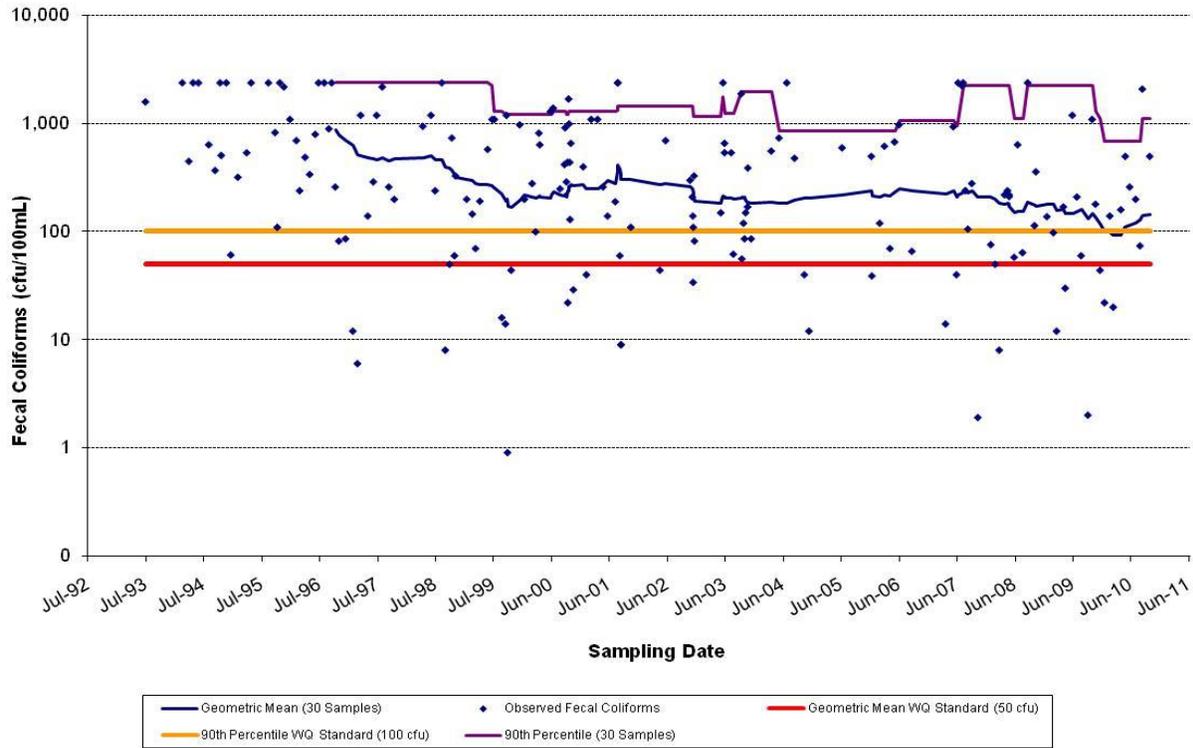


Figure 6.5 Class AA Fresh Water Fecal Coliform Bacteria Results – 30 Sample Running Geometric Mean and 90th Percentile at Site SW009

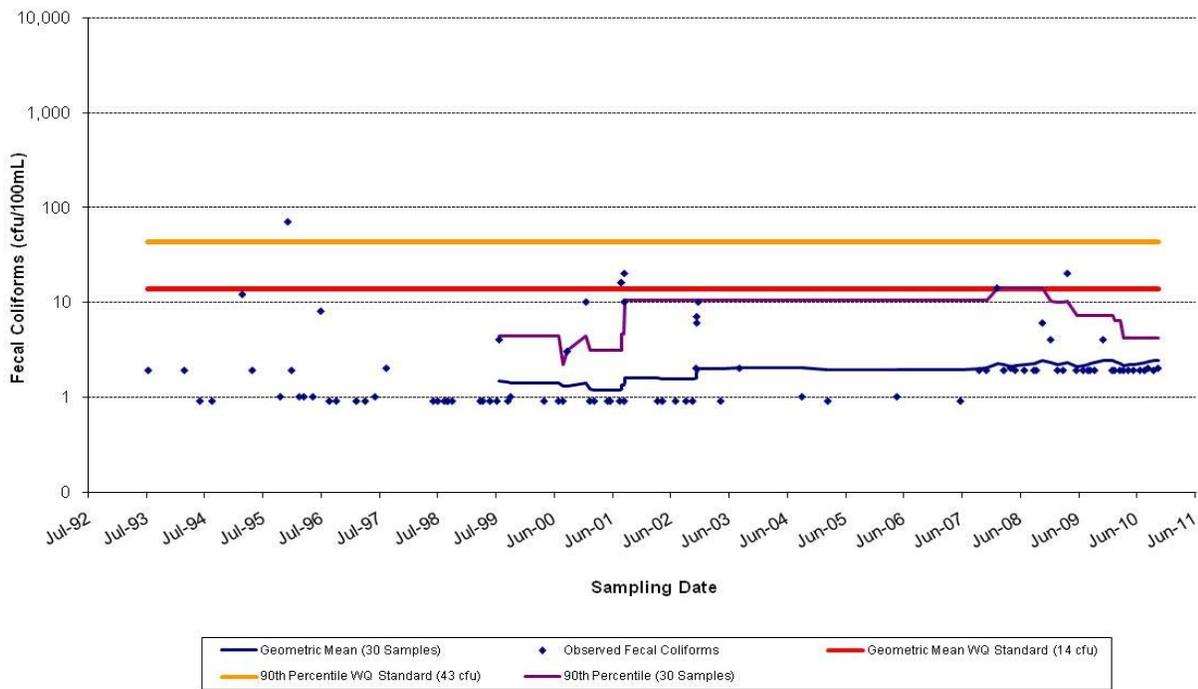


Figure 6.6 Class AA Marine Water Fecal Coliform Bacteria Results – 30 Sample Running Geometric Mean and 90th Percentile at Site SW002

6.1.2. Class A Waters

The Class A fresh water standard for fecal coliform bacteria are a geometric mean not to exceed 100 cfu/100 ml and a 90th percentile (from the values used to calculate the geometric mean) not to exceed 200 cfu/100 ml. Although sites SW025, SW035, and SW037 are shown in Figure 6.7 to have met the standards during 2010, these results reflect only two or three samples. Sample Site SW031 and Site SW033 also met the fecal coliform water quality standard during 2010. As shown in Figure 6.8, the geometric mean was below the standard at 8 of the 9 Class A fresh water sample sites for the period of record through 2009, but the 90th percentile values were above the standard at all the sites, except Site SW031, which drains a forested wetland along Lummi Shore Road. The sites with the highest geometric mean and 90th percentile are located on Portage Island (SW024, SW025, SW026, SW027, and SW028). Although elevated fecal coliform bacteria levels have been sampled at the Class A freshwater sites, as noted above, the water bodies are seasonally dry and have low discharges during the rainy season. The results from an intensive sampling effort in the adjacent area along the Lummi Peninsula suggest that discharge from these sites have minimal or no measurable impact on the water quality of the receiving marine waters (LWRD 1999, LWRD 2006b, LWRD 2006c).

The Class A marine water quality standards for fecal coliform bacteria are more stringent than for Class A fresh water quality standards and include a geometric mean not to exceed 14 cfu/100 ml and a 90th percentile (from the values used to calculate the geometric mean) not to exceed 43 cfu/100 ml. As shown in Figure 6.9, the standards were met at 12 of the 18 sample sites during 2010. As shown in Figure 6.10, 11 of the 18 sites met the criteria for the period of record; all the sites had geometric means below the standard for the period of record.

Figure 6.11 depicts the 30 sample running geometric mean and 90th percentile of fecal coliform bacteria at the mainstem of the Nooksack River just below the Marine Drive Bridge (SW018/SW118). Site SW018/SW118 is the representative Class AA fresh water site that contributes to a Class A marine water site. As shown in Figure 6.11, from 1998 through 2003 there is a general trend of decreasing fecal coliform bacteria densities. During late 2003 through 2004, fecal coliform bacteria densities increased and exceeded both the Lummi Nation Water Quality Standards (WQS) for Class AA fresh water and the TMDL target (Ecology 2000, 2002). Fecal coliform bacteria levels dropped below the Lummi Nation WQS and the TMDL target during late 2005 through early 2007. During this period, there also was reduced sampling due to staff changes. The fecal coliform bacteria geometric mean decreased to below the TMDL Target in 2008 and 2009, however there continues to be periodic samples with high fecal coliform bacteria levels in the Nooksack River. Consequently, the fecal coliform bacteria levels were not meeting the 90th percentile standard. During 2010, Site SW018/SW118 was lower than the Lummi Nation fecal coliform bacteria geometric mean standard of 50 cfu/100 ml, the Total Maximum Daily Load (TMDL) target of 39 cfu/100 ml established for the lower Nooksack River (Ecology 2000, 2002), and the 90th Percentile standard of 100 cfu/100 ml. The water quality standard at Site SW118 was achieved during 2010 and the designated uses are supported.

Figure 6.12 depicts the 30 sample running geometric mean and 90th percentile of fecal coliform bacteria for Site SW030 in Bellingham Bay between the Nooksack River Delta and Portage Bay. The fecal coliform bacteria sample results for this representative Class A marine water site have been similar to the results from SW018/SW118 over the period of record. During 1998 through 2003, there was a general trend of decreasing fecal coliform bacteria density. Similar to the Nooksack River site (SW018/SW118), fecal coliform bacteria levels at the Bellingham Bay near shore site (SW030) increased from 2004 to 2009 and improved during 2010. Sample Site SW030 met the geometric mean standard during 2010, but the 90 percentile value was above the standard. The decreasing trend of fecal coliform bacteria in the Nooksack River and Bellingham Bay is a sign of improving water quality in the Nooksack River watershed and Bellingham Bay after several years of high bacteria densities.

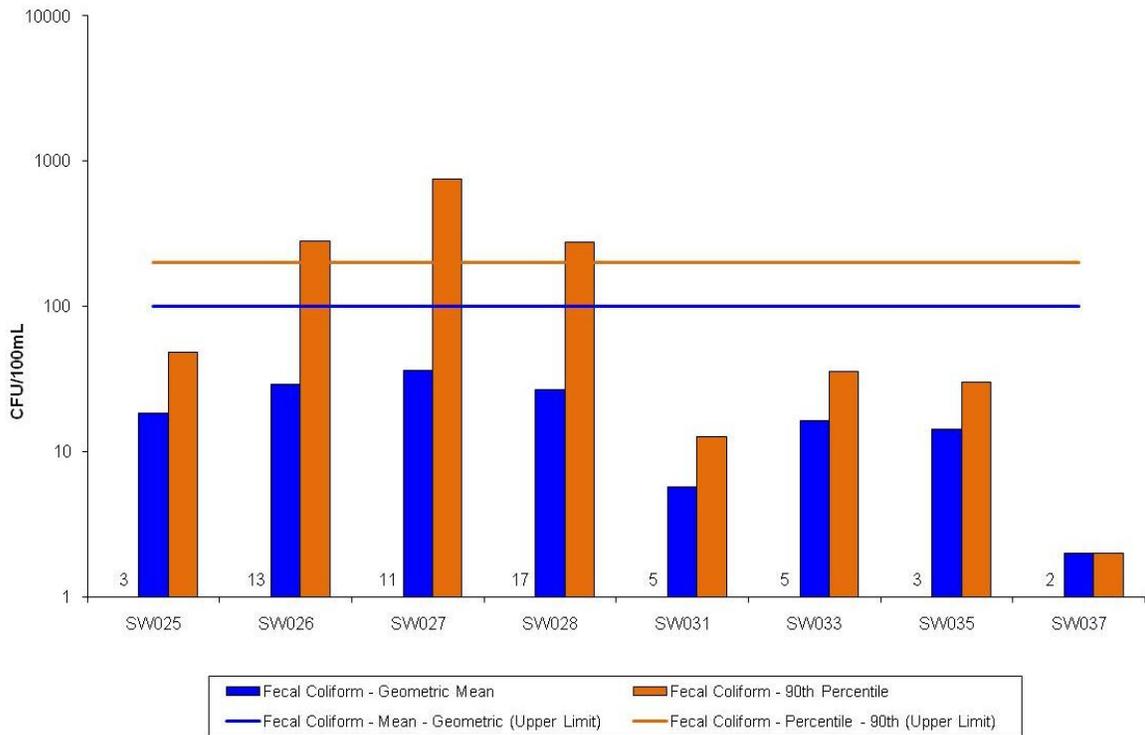


Figure 6.7 Class A Fresh Water Fecal Coliform Bacteria Results Compared with Water Quality Standards: 2010

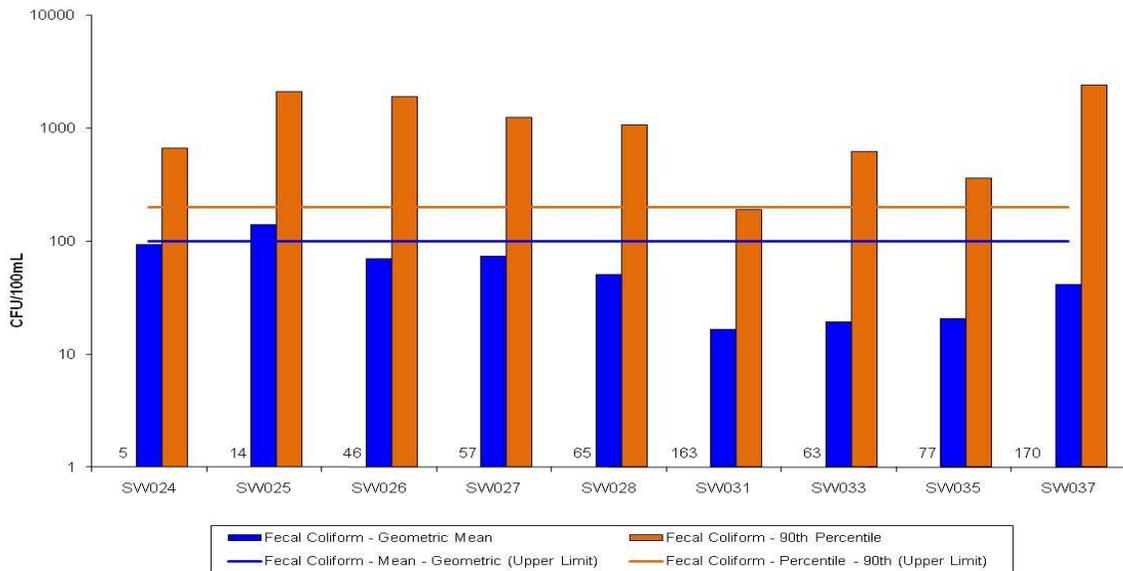


Figure 6.8 Class A Fresh Water Fecal Coliform Bacteria Results Compared with Water Quality Standards: Period of Record through 2009

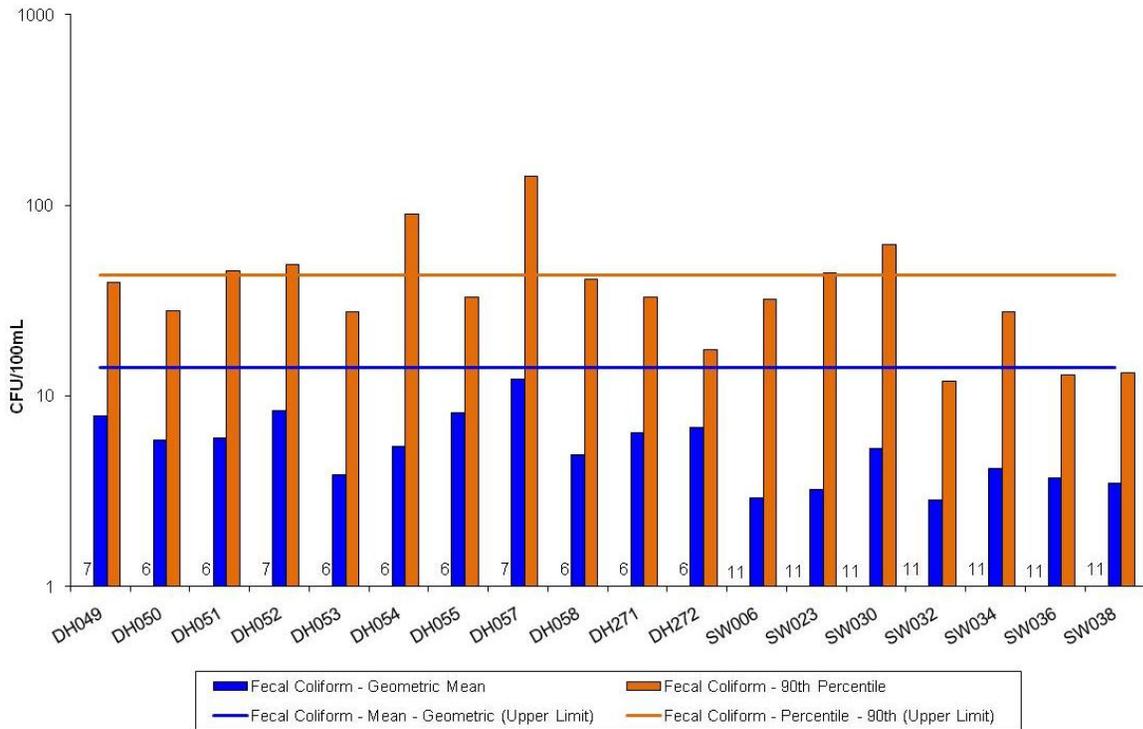


Figure 6.9 Class A Marine Water Fecal Coliform Bacteria Results Compared with Water Quality Standards: 2010

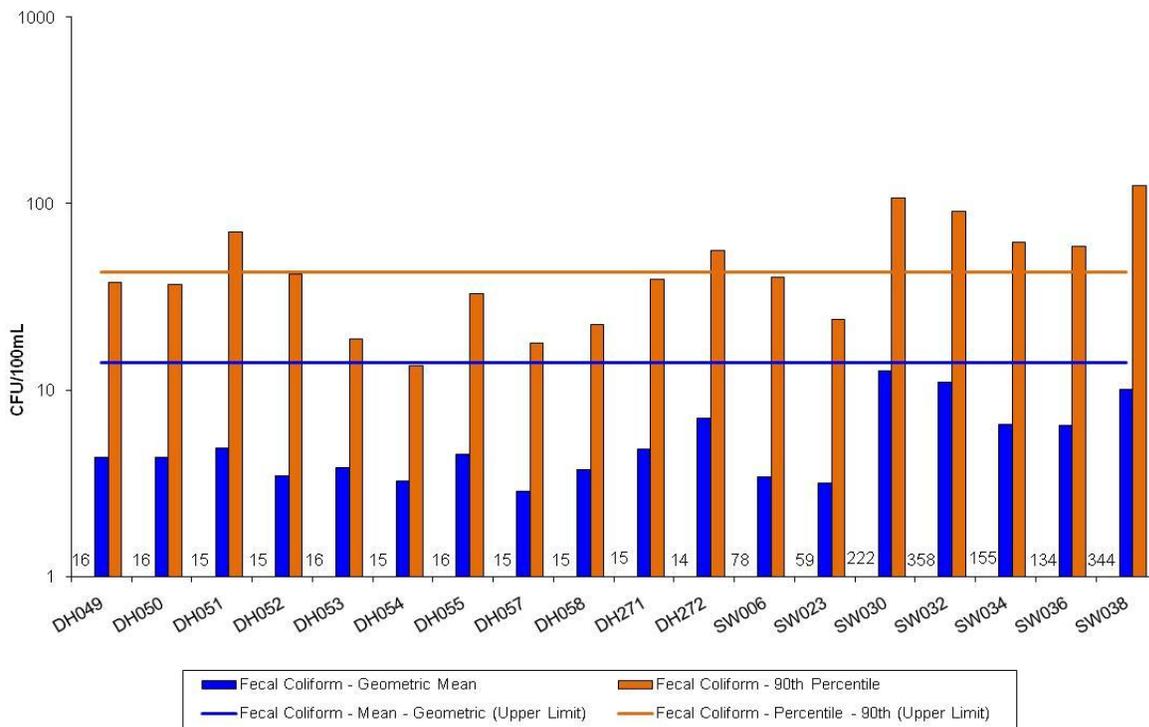


Figure 6.10 Class A Marine Water Fecal Coliform Bacteria Results Compared with Water Quality Standards: Period of Record through 2009

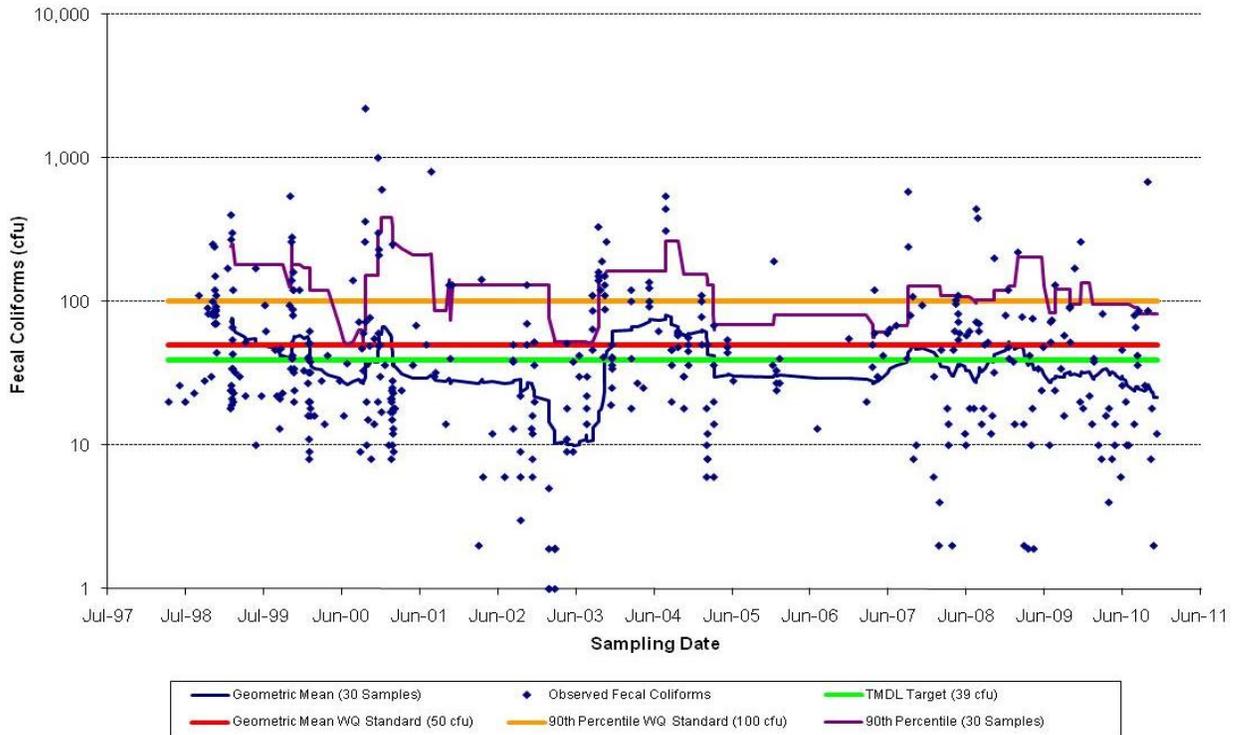


Figure 6.11 Class AA Fresh Water Fecal Coliform Bacteria Results – 30 Sample Running Geometric Mean and 90th Percentile at Site SW018/SW118 (Nooksack River)

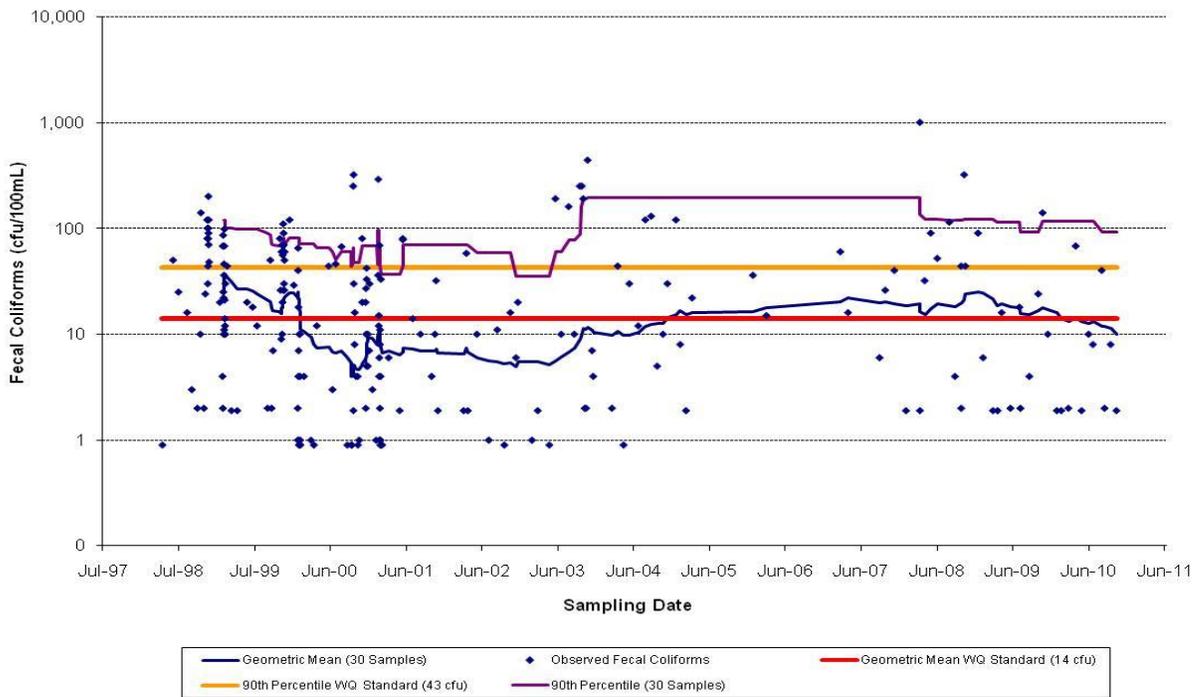


Figure 6.12 Class A Marine Water Fecal Coliform Bacteria Results – 30 Sample Running Geometric Mean and 90th Percentile at Site SW030

6.2. Enterococcus Results

As described in Section 6.1, collected water quality samples are transported on ice to a contracted analytical laboratory the day of collection and tested for fecal coliform bacteria, *E. coli*, and enterococcus. Water from one sample bottle is used for each of the tests; fecal coliform bacteria and *E. coli* are enumerated from the same growth plates.

6.2.1. Class AA Waters

The Class AA fresh water standards for enterococcus bacteria are a geometric mean not to exceed 33 cfu/100 ml and not exceed a single sample maximum allowable density of 61 cfu/100 ml. As shown in Figure 6.13, the geometric mean was below the standard at 6 of the 16 sample sites during 2010 but the single sample maximum allowable density was exceeded at all 16 sites. As shown in Figure 6.14, the geometric mean was below the standard at 7 of the 16 sample sites for the period of record through 2009. However, because the single maximum allowable density criterion was exceeded at all 16 sites, the water quality standard for enterococcus was not achieved at any of the Class AA fresh water sample sites for the period of record or during 2010. The site with the highest geometric mean and single sample density percentile was Site SW009, the Lummi River at the Reservation boundary. Additional sites along the northern and eastern Reservation boundary (SW010, SW011, SW012, SW013, SW014, SW016, and SW017) had high geometric mean and single sample maximum allowable density values. Sample sites SW003 and SW058 are downstream from these sites along the boundary and also experienced high enterococcus counts.

The Class AA marine water standards for enterococcus are a geometric mean not to exceed 35 cfu/100 ml and not exceed a single sample maximum allowable density of 104 cfu/100 ml. As shown in Figure 6.15, 7 of the 12 sample sites met these criteria during 2010. All sample results at Site SW002 had values too low for the laboratory to detect (10 cfu/100ml) for enterococcus during 2010. As shown in Figure 6.16, sites SW001, SW002, and SW022 met the criteria for the period of record. The site with the highest geometric mean and single sample maximum density value was Site SW008, Lummi River at Hillaire Bridge. Site SW008 is downstream from Site SW009 on the Lummi River but is classified as a marine water site due to the observed salinity levels at the site. Similar to previous years, the water quality at Site SW009 during 2010 was of poorer quality than Site SW008.

As summarized in Table 6.1, the relation between fecal coliform bacteria and enterococcus bacteria varies by site and there is generally a poor relationship between the two types of bacteria. The best relationships, defined by the highest coefficient of determination (r^2) and slope of the best-fit line close to 1 was Site SW022 (Lummi Bay near Sandy Point). At Site SW022, as fecal coliform bacteria values increased, enterococcus values increased. Because fecal coliform bacteria occur in human feces, but can also be present in animal feces, soil, and submerged wood and in other places outside the human body, and enterococcus are typically a more human-specific subgroup within the larger fecal coliform bacteria group, the very good relationship at this site suggests that the source of fecal coliform bacteria is from human waste. The location of Site SW022 corresponds with an upland area where residents rely on on-site septic systems for waste disposal.

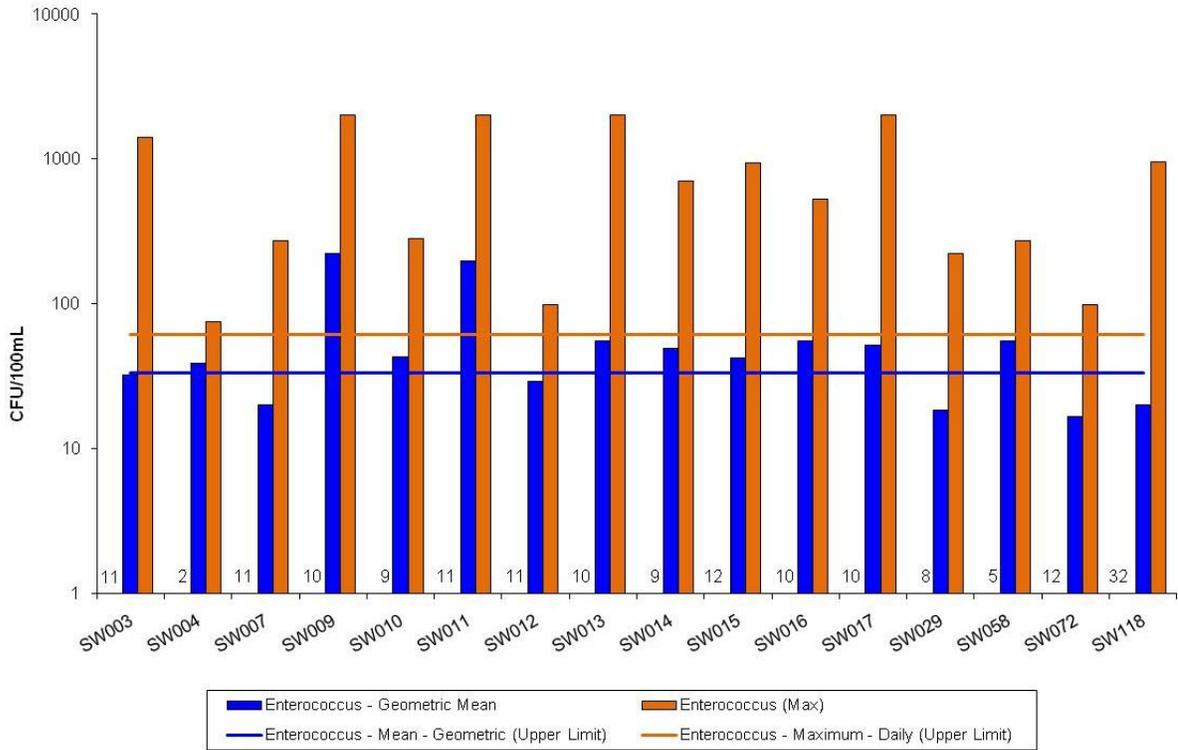


Figure 6.13 Class AA Fresh Water Enterococcus Bacteria Results Compared with Water Quality Standards: 2010

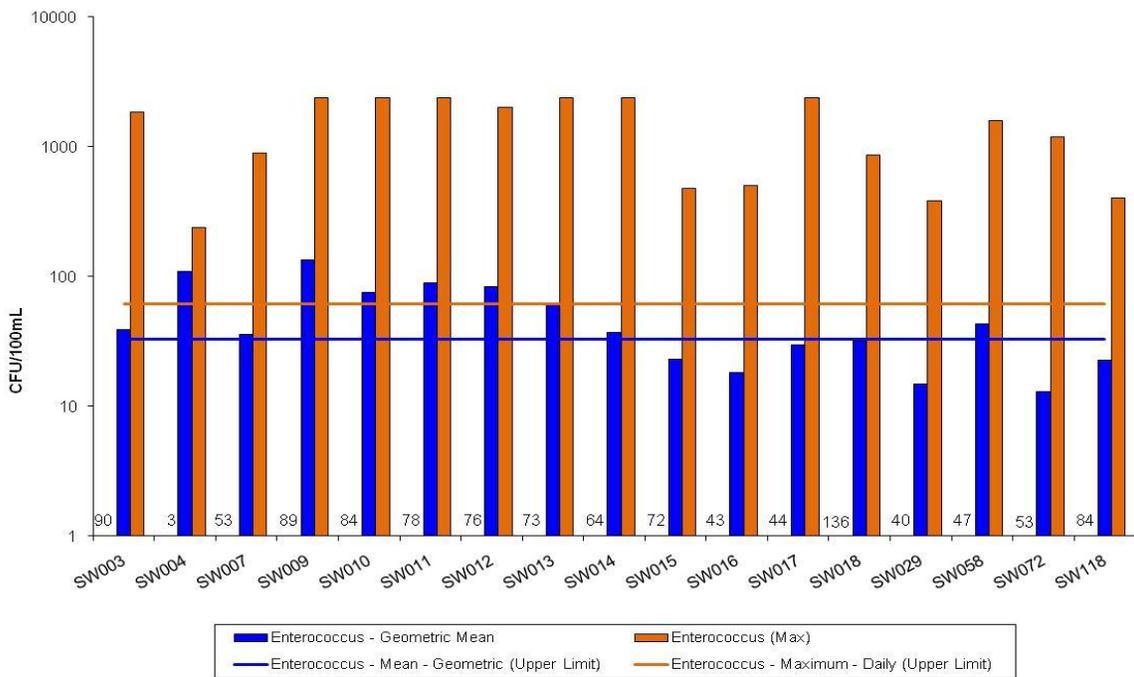


Figure 6.14 Class AA Fresh Water Enterococcus Bacteria Results Compared with Water Quality Standards: Period of Record through 2009

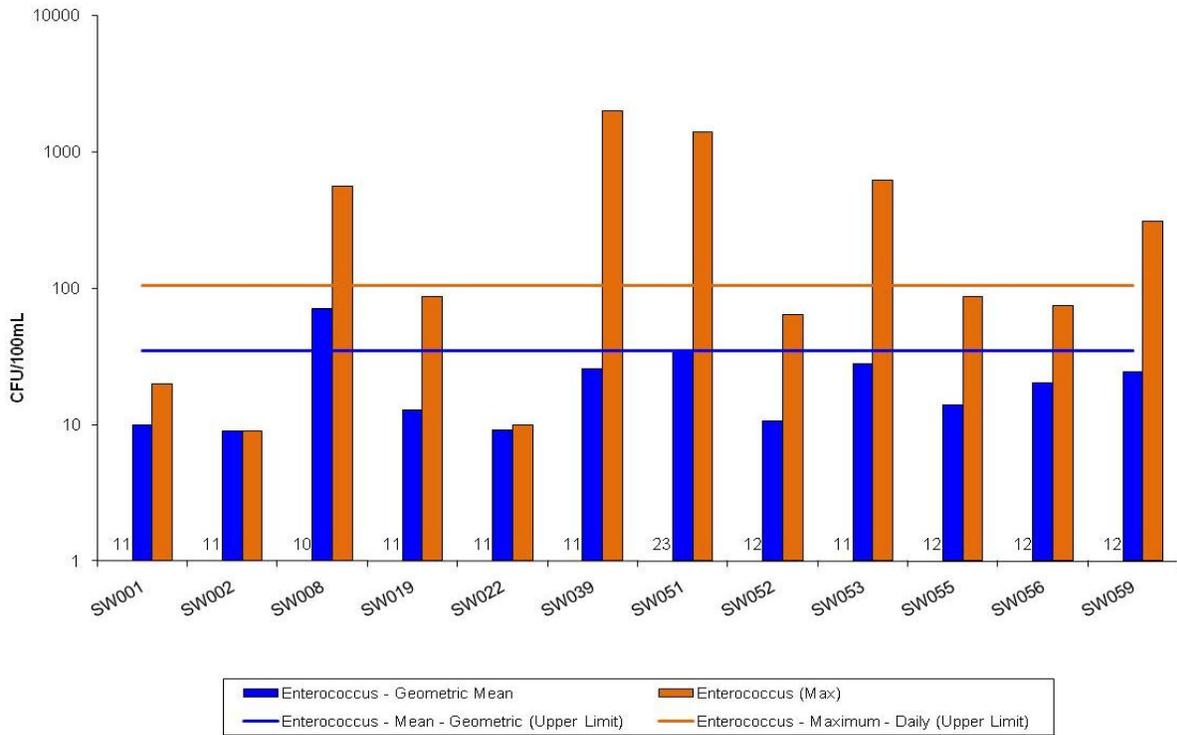


Figure 6.15 Class AA Marine Water Enterococcus Bacteria Results Compared with Water Quality Standards: 2010

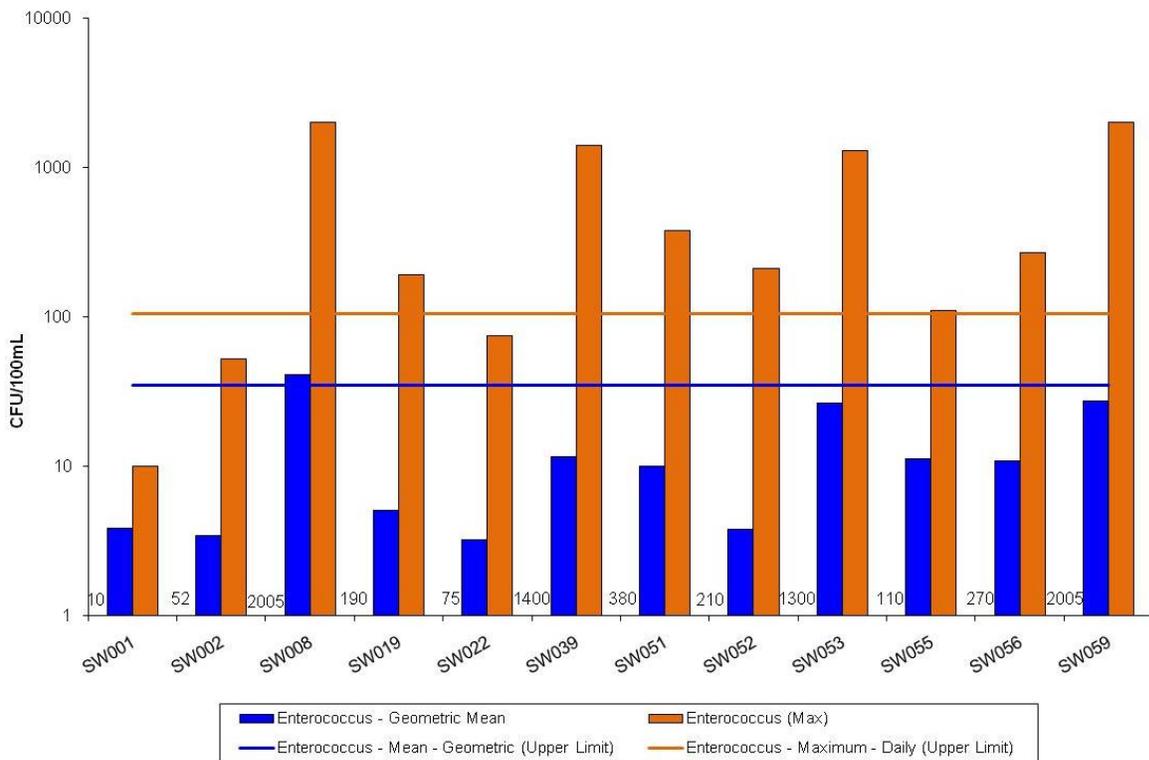


Figure 6.16 Class AA Marine Water Enterococcus Bacteria Results Compared with Water Quality Standards: Period of Record through 2009

Table 6.1 Relation Between Fecal Coliform and Enterococcus Bacteria – Class AA Waters

Sample Site Number	Number of Sample Pairs	Slope	Intercept	R-Square
Fresh Water				
SW003	101	0.58	53.90	0.68
SW007	64	0.95	18.03	0.46
SW009	99	1.28	58.90	0.41
SW010	93	0.75	17.94	0.60
SW011	89	1.28	75.69	0.36
SW012	87	2.18	-23.35	0.62
SW013	82	0.13	88.47	0.13
SW014	73	0.39	150.66	0.24
SW015	83	0.63	57.78	0.23
SW016	51	0.21	21.71	0.11
SW017	53	0.78	-26.24	0.52
SW029	48	0.66	54.75	0.15
SW058	52	0.61	151.47	0.11
SW072	63	0.12	41.64	0.10
SW118	256	0.54	30.39	0.42
Marine Water				
SW001	50	0.29	1.31	0.12
SW002	59	0.26	1.77	0.15
SW008	87	1.95	22.93	0.52
SW019	52	0.20	3.23	0.28
SW022	43	0.52	-1.16	0.89
SW039	87	0.02	11.98	0.05
SW051	146	0.07	31.34	0.01
SW052	76	0.14	2.71	0.14
SW053	84	0.38	30.71	0.65
SW055	38	0.78	8.18	0.10
SW056	77	1.00	33.81	0.06
SW059	77	0.69	36.31	0.64

6.2.2. Class A Waters

The Class A fresh water standards for enterococcus bacteria include a geometric mean not to exceed 33 cfu/100 ml and not to exceed a single sample maximum allowable density of 61 cfu per 100 ml. Although sample sites SW025, SW035, and SW037 are shown in Figure 6.17 to have met this standard during 2010, these results reflect laboratory findings from two or three samples. Sites SW031 and SW033, storm water outfalls draining undeveloped parcels along the Portage Bay shoreline, met both criteria during 2010. As shown in Figure 6.18, the geometric mean was below the standard at eight of the nine sample sites for the period of record through 2009. However, because the single sample criteria were exceeded at eight of the nine sites, the water quality standard for enterococcus was only achieved at Site SW024 for the period of record. It is noted that there were only two samples for Site SW024. The site with the highest geometric mean and single sample values both during 2010 and over the period of record is Site SW037, which is located along Hermosa Beach, a developed portion of the Lummi Peninsula.

The Class A marine water quality standards for enterococcus are a geometric mean not to exceed 35 cfu/100 ml and not to exceed a single sample maximum allowable density of 104 cfu/100 ml. As shown in Figure 6.19, the geometric mean component of the water quality standard was met at all sample sites during 2010, while the single sample maximum density component was only achieved at sites SW034, SW036, and SW038. As shown in Figure 6.20, similar to 2010, the geometric mean was lower than the standard at all sample sites but both criteria were not achieved for any of the sites for the period of record due to the exceedence of the single sample maximum density criteria.

As summarized in Table 6.2, the relation between fecal coliform bacteria and enterococcus bacteria varies by site and there is a generally poor relationship between the two types of bacteria. The best relationships, as defined by the highest coefficient of determination (r^2) and the slope of the best-fit line closest to 1, are Site SW036 and Site SW037 (along Lummi Peninsula/Portage Bay shoreline). The relationship between fecal coliform bacteria and enterococcus bacteria at Site SW036 and Site SW037 is very good, as fecal coliform bacterial values increased enterococcus values increased. As described in section 6.2.1, a similar trend between fecal coliform and enterococcus indicates that the source of fecal coliform at Site SW036 and Site SW037 is from human waste.

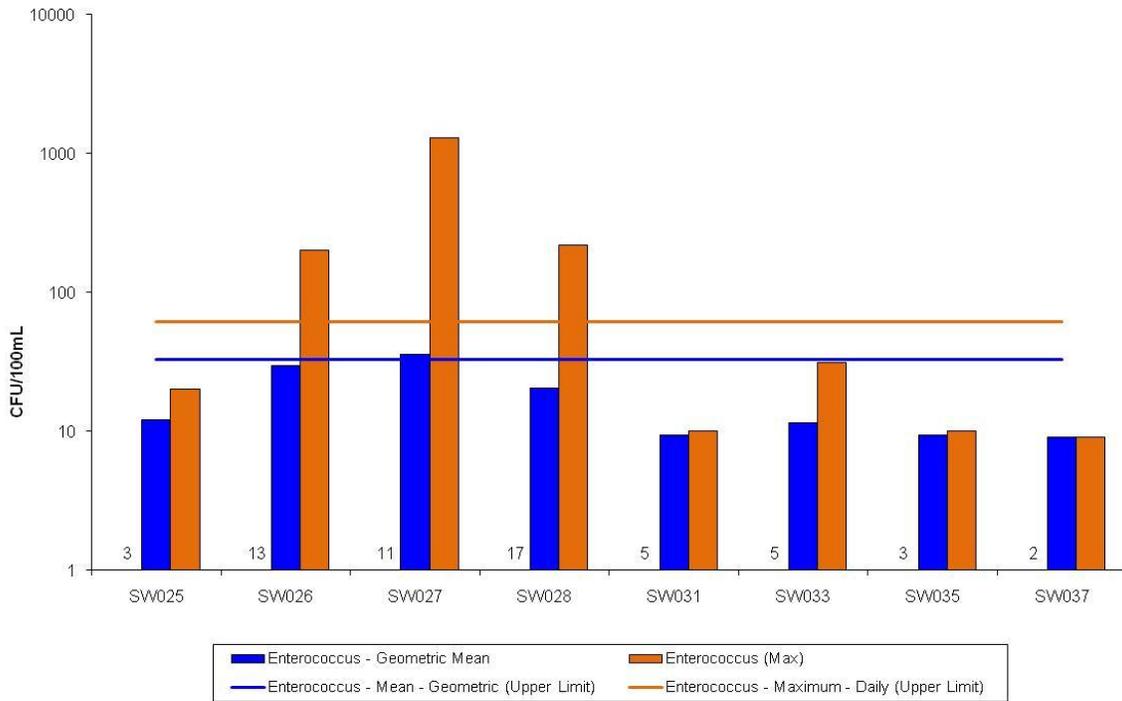


Figure 6.17 Class A Fresh Water Enterococcus Results Compared with Water Quality Standards: 2010

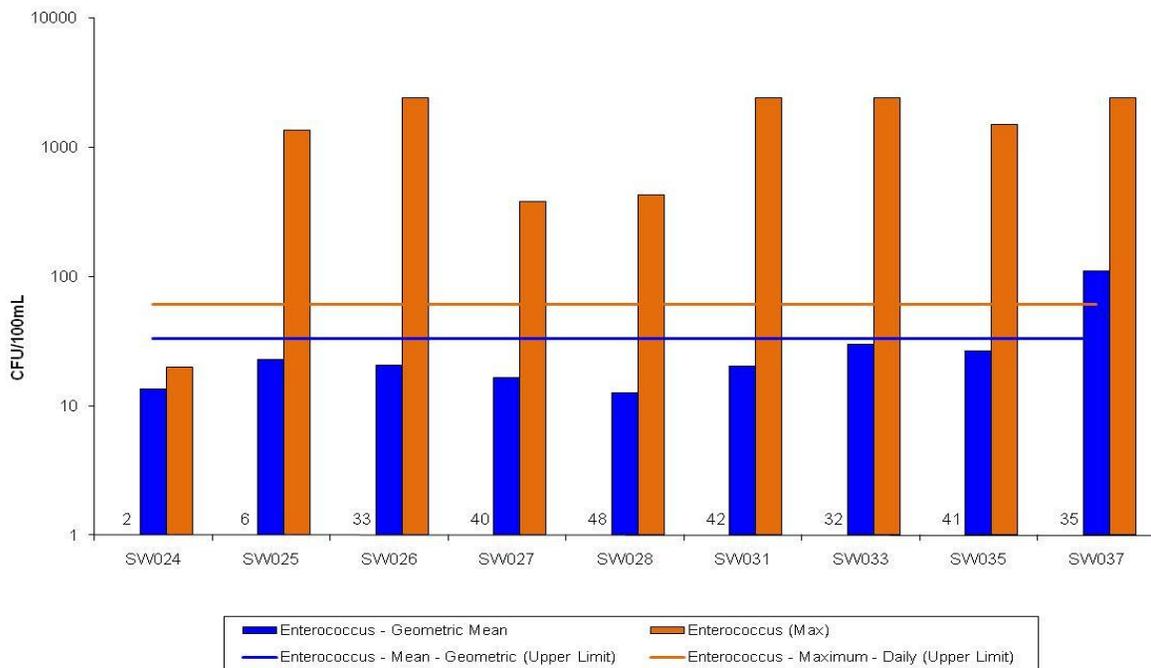


Figure 6.18 Class A Fresh Water Enterococcus Results Compared with Water Quality Standards: Period of Record through 2009

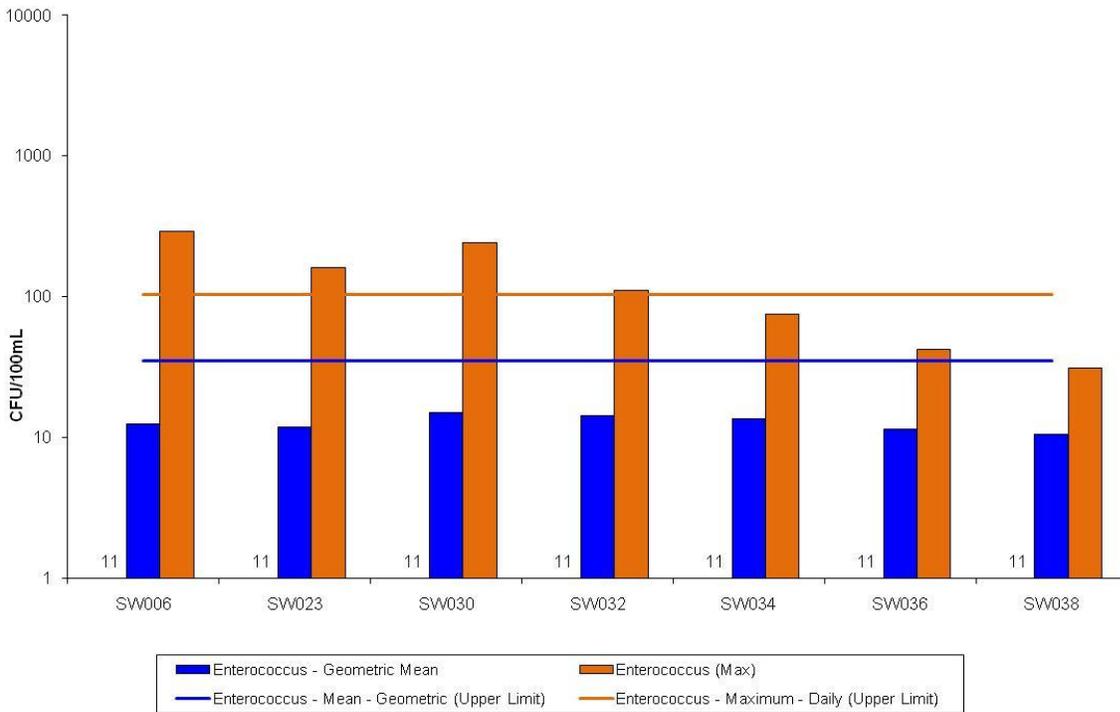


Figure 6.19 Class A Marine Water Enterococcus Results Compared with Water Quality Standards: 2010

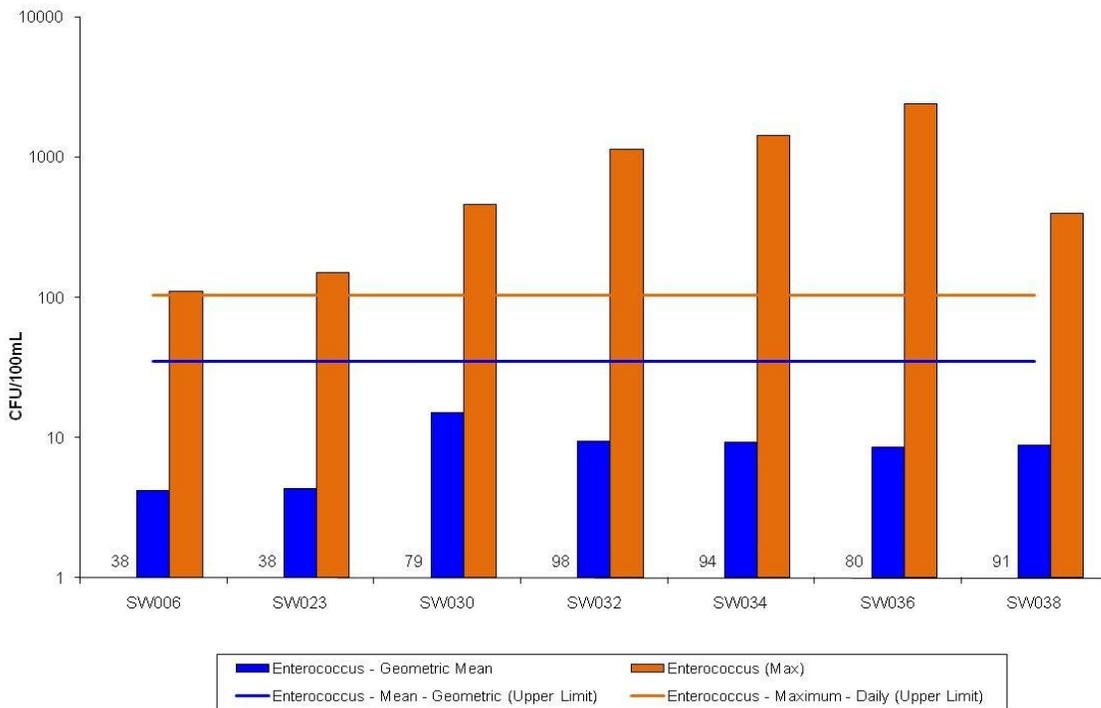


Figure 6.20 Class A Marine Water Enterococcus Bacteria Results Compared with Water Quality Standards: Period of Record through 2009

Table 6.2 Relation Between Fecal Coliform and Enterococcus Bacteria – Class A Waters

Sample Site Number	Number of Sample Pairs	Slope	Intercept	R-Square
Fresh Water				
SW025	9	1.21	139.48	0.75
SW026	65	3.00	155.22	0.42
SW027	72	0.42	222.40	0.02
SW028	92	8.16	-117.53	0.44
SW032	109	0.55	5.67	0.69
SW034	105	0.42	5.82	0.56
SW036	91	1.09	-2.22	0.99
SW038	101	0.34	6.56	0.54
Marine Water				
SW006	49	0.22	4.32	0.34
SW023	49	0.64	0.98	0.71
SW030	92	0.52	35.14	0.08
SW031	47	0.48	7.24	0.70
SW033	37	0.14	96.15	0.63
SW035	44	0.46	17.48	0.50
SW037	37	2.69	-604.27	0.97

6.3. *Escherichia coli* Results

As described in Section 6.1, collected water quality samples are transported on ice to a contracted analytical laboratory the day of collection and water from one sample bottle is used for each of the tests for bacteria; fecal coliform bacteria and *Escherichia coli* (*E. coli*) are enumerated from the same growth plates.

Escherichia coli (*E. coli*) is a type of fecal coliform bacteria that is specific to fecal material from humans and other warm-blooded animals. The Lummi Nation did not establish a water quality standard for *E. coli*, primarily because fecal coliform bacteria is the criterion used to classify commercial shellfish beds in the federal Food and Drug Administration (FDA) National Shellfish Sanitation Program (NSSP). Although there is currently not an adopted water quality standard for *E. coli*, the Program samples for *E. coli* since the EPA recommends *E. coli* as the best indicator of health risk from water contact in recreational waters and because an *E. coli* standard might be adopted in the future.

6.3.1. Class AA Waters

As summarized in Table 6.3, the fecal coliform bacteria results are generally highly correlated (coefficients of determination greater than 0.90 and slope of the best-fit line close to 1) with the *E. coli* results. The generally high correlations are not surprising since *E. coli* is a species in the fecal coliform bacteria group. The high correlation indicates that the measured fecal coliform bacteria levels are from fecal material from humans and other warm-blooded animals rather than from other bacteria types that are not necessarily fecal in origin (e.g., *Klebsiella*). Although still highly correlated with a coefficient of determination greater than 0.60, the correlation between fecal coliform bacteria and *E. coli* at sample sites SW002 and SW007 are lower and the deviation from a 1:1 slope of a best fit line is notably greater than for the majority of the other sites. Sample Site SW001 (Sandy Point Channel) has the poorest relationship between fecal coliform bacteria and *E. coli*, which indicates that the *E. coli* are more likely to be from other bacteria types that are not necessarily fecal in origin.

The high correlation is reflected in similar trends of fecal coliform bacteria and *E. coli* densities at the majority of sample sites. As shown in Figure 6.21 and Figure 6.22, the Class AA fresh water sites with the highest geometric mean and 90th percentile values were sites SW009, SW010, SW011, SW012, and SW014 along the northern Reservation boundary. As shown in Figure 6.23 and Figure 6.24, the Class AA marine sites with the highest mean geometric mean and 90th percentile values were sites SW008, SW053, SW056, and SW059. Sample Site SW008 is downstream from Site SW009 on the Lummi River but is classified as a marine water site. Although the *E. coli* density at Site SW053 is high, it is lower than the respective upstream Site SW003.

Table 6.3 Relation Between Fecal Coliform Bacteria and *E.coli* – Class AA Waters

Sample Site Number	Number of Sample Pairs	Slope	Intercept	R-Square
Fresh Water				
SW003	139	1.00	1.72	1.00
SW007	102	0.99	17.10	0.78
SW009	138	1.00	18.26	0.99
SW010	140	1.00	7.07	1.00
SW011	131	1.02	7.61	0.99
SW012	126	0.99	25.21	0.99
SW013	124	0.99	6.11	0.98
SW014	108	1.00	5.25	0.99
SW015	115	0.99	2.69	0.99
SW016	76	0.99	9.53	0.96
SW017	75	1.00	1.79	1.00
SW029	173	1.00	3.35	0.99
SW058	58	1.05	26.48	0.92
SW072	64	0.97	2.83	0.92
SW118	405	1.00	3.47	0.97
Marine Water				
SW001	51	0.94	0.56	0.52
SW002	74	0.96	0.68	0.63
SW008	126	1.01	4.85	0.99
SW019	66	0.98	0.77	0.82
SW022	57	0.99	0.10	0.99
SW039	173	1.00	1.07	0.99
SW051	171	1.11	-0.81	0.98
SW052	88	1.00	0.06	1.00
SW053	103	0.99	3.22	0.97
SW055	39	0.99	1.76	0.96
SW056	86	1.00	0.72	1.00
SW059	82	0.99	4.28	0.99

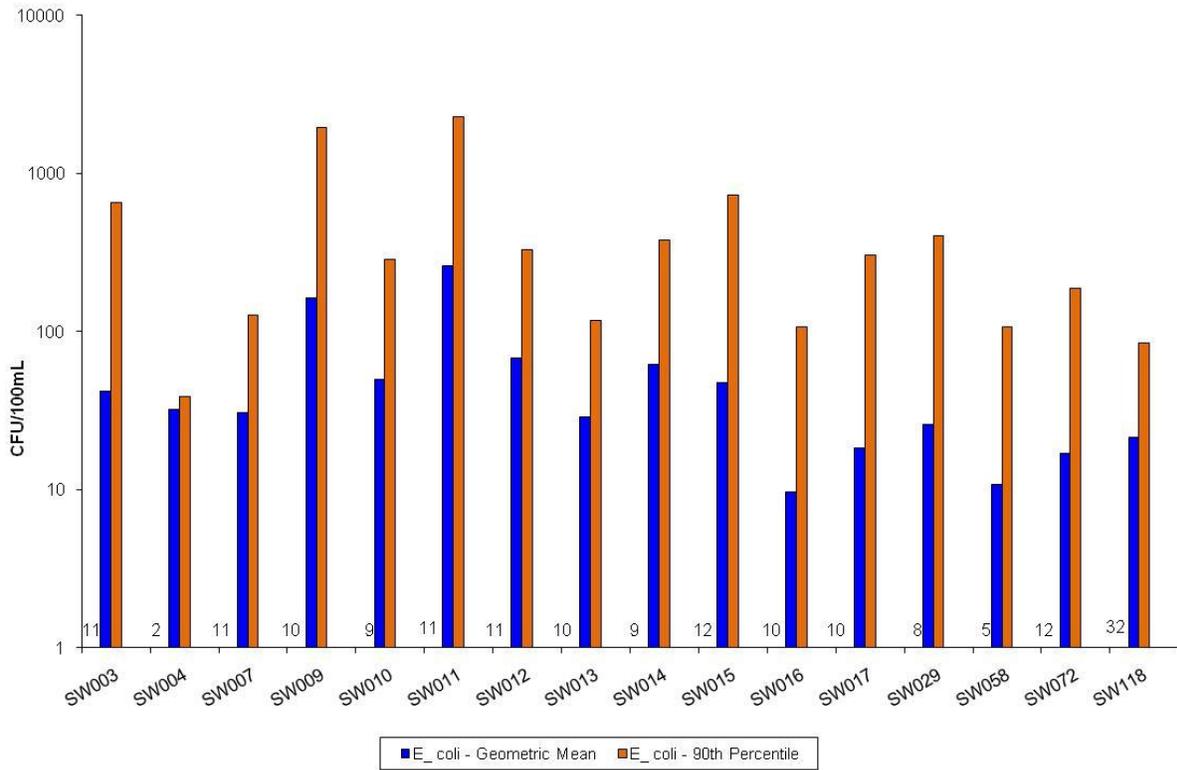


Figure 6.21 Class AA Fresh Water *E.coli* Results: 2010

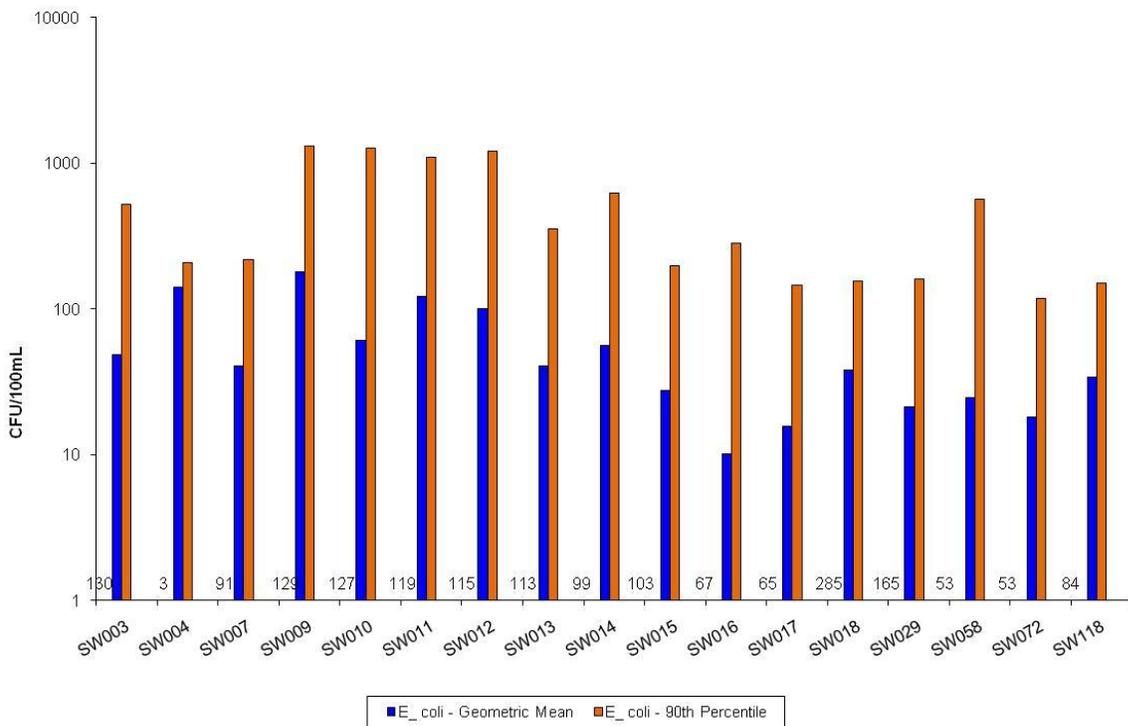


Figure 6.22 Class AA Fresh Water *E.coli* Results: Period of Record through 2009

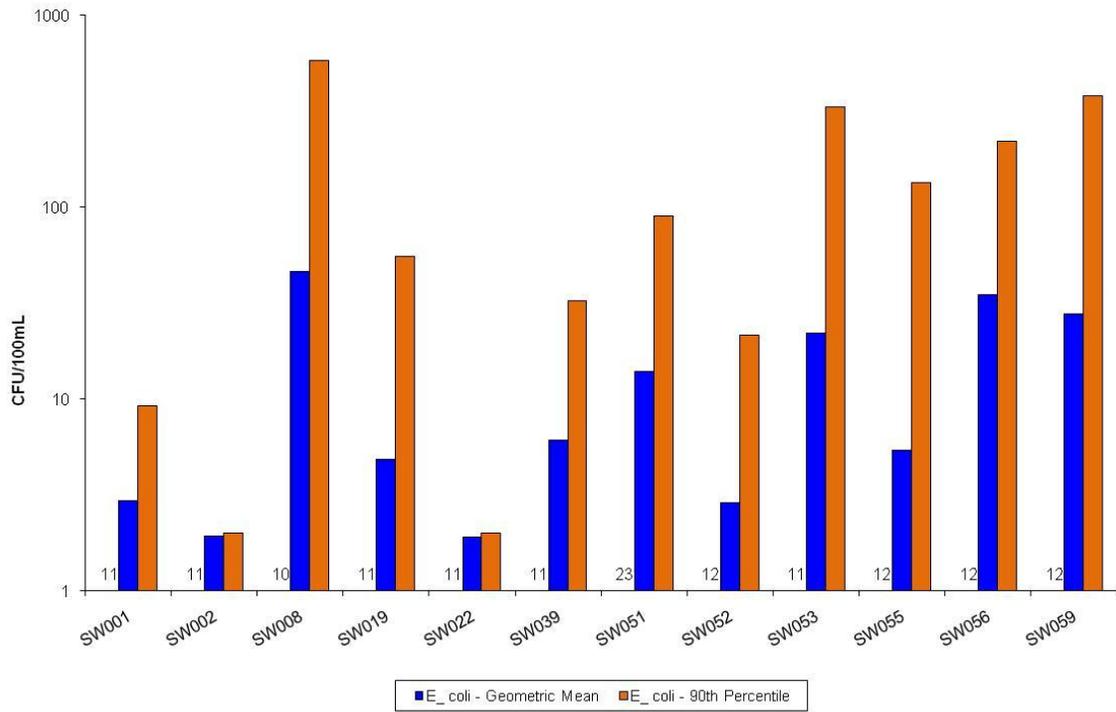


Figure 6.23 Class AA Marine Water *E.coli* Results: 2010

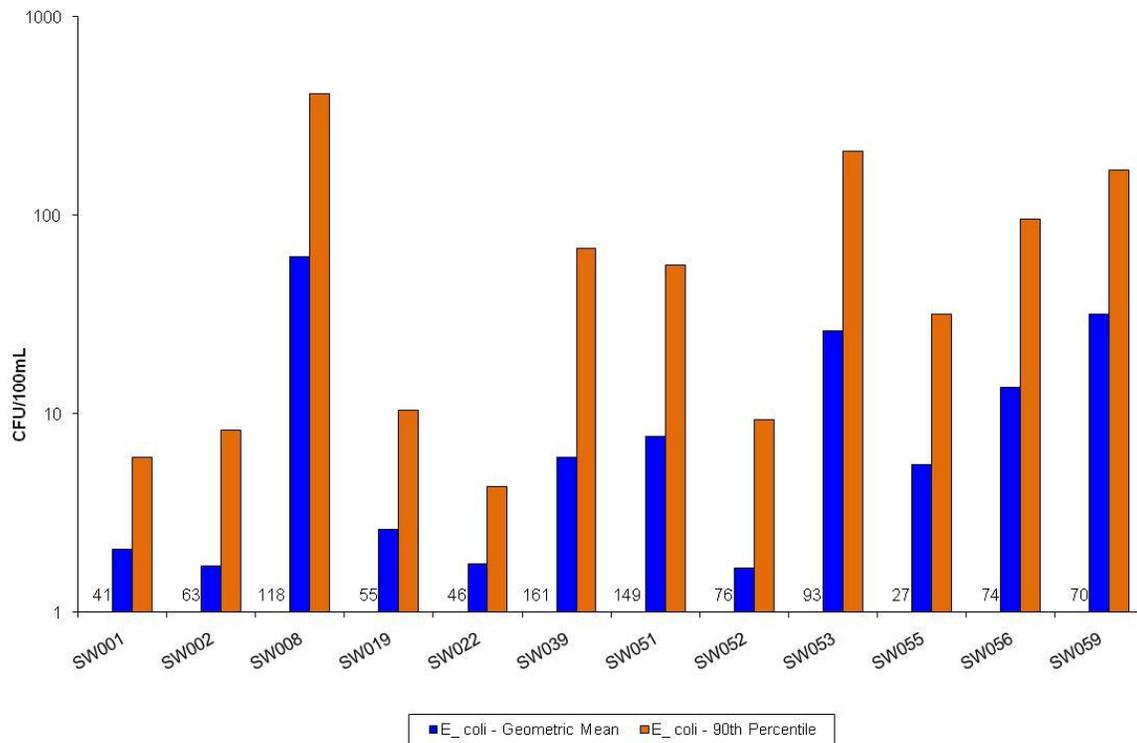


Figure 6.24 Class AA Marine Water *E.coli* Results: Period of Record through 2009

6.3.2. Class A Waters

As summarized in Table 6.4, the fecal coliform bacteria results for Class A waters were highly correlated (coefficients of determination greater than 0.90 and slope of the best-fit line close to 1) with the *E. coli* results. As described in section 6.3.1, the generally high correlations are not surprising since *E. coli* is a species in the fecal coliform bacteria group. The high correlation indicates that the fecal coliform bacteria are from fecal material from humans and other warm-blooded animals rather than from other bacteria types that are not necessarily fecal in origin (e.g., *Klebsiella*). Sample Site SW030 (in Bellingham Bay) has the poorest relationship between fecal coliform bacteria and *E. coli* with a coefficient of determination of 0.37 and slope of 0.56.

The generally high correlation between fecal coliform bacteria and *E. coli* is reflected in similar trends of fecal coliform bacteria and *E. coli* densities at sample sites. As shown in Figure 6.25 and Figure 6.26, the Class A fresh water sites with the highest geometric means and 90th percentiles are located on Portage Island (SW024, SW025, SW026, SW027, and SW028). As shown in Figure 6.27 sites SW032, SW036, and SW038 located along Hermosa Beach had the lowest geometric mean and 90th percentile for Class A marine water sites during 2010. In contrast, as shown in Figure 6.28, site SW038 has one of the highest geometric mean and 90th percentile for a Class A marine water for the period of record.

Table 6.4 Relation Between Fecal Coliform Bacteria and *E.coli* – Class A Waters

Sample Site Number	Number of Sample Pairs	Slope	Intercept	R-Square
Fresh Water				
SW025	17	0.98	72.38	0.98
SW026	78	1.00	0.23	1.00
SW027	88	0.99	13.68	0.99
SW028	111	0.98	7.20	0.96
SW032	381	1.00	18.29	0.99
SW034	174	1.00	0.57	0.99
SW036	143	1.00	0.57	1.00
SW038	366	1.00	1.87	1.00
Marine Water				
SW006	76	1.00	0.18	1.00
SW023	74	1.00	0.30	0.99
SW030	233	0.62	19.18	0.37
SW031	167	1.00	-0.56	1.00
SW033	66	1.00	0.53	1.00
SW035	78	1.00	2.50	1.00
SW037	166	1.00	16.08	1.00

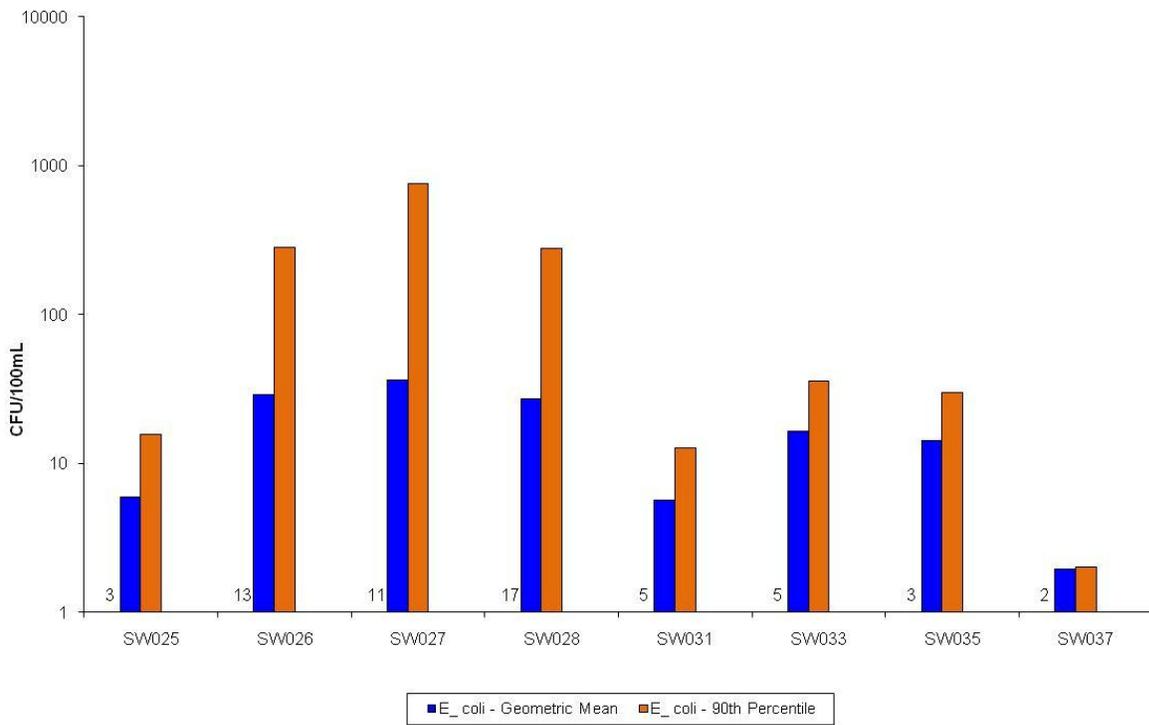


Figure 6.25 Class A Fresh Water *E.coli* Results: 2010

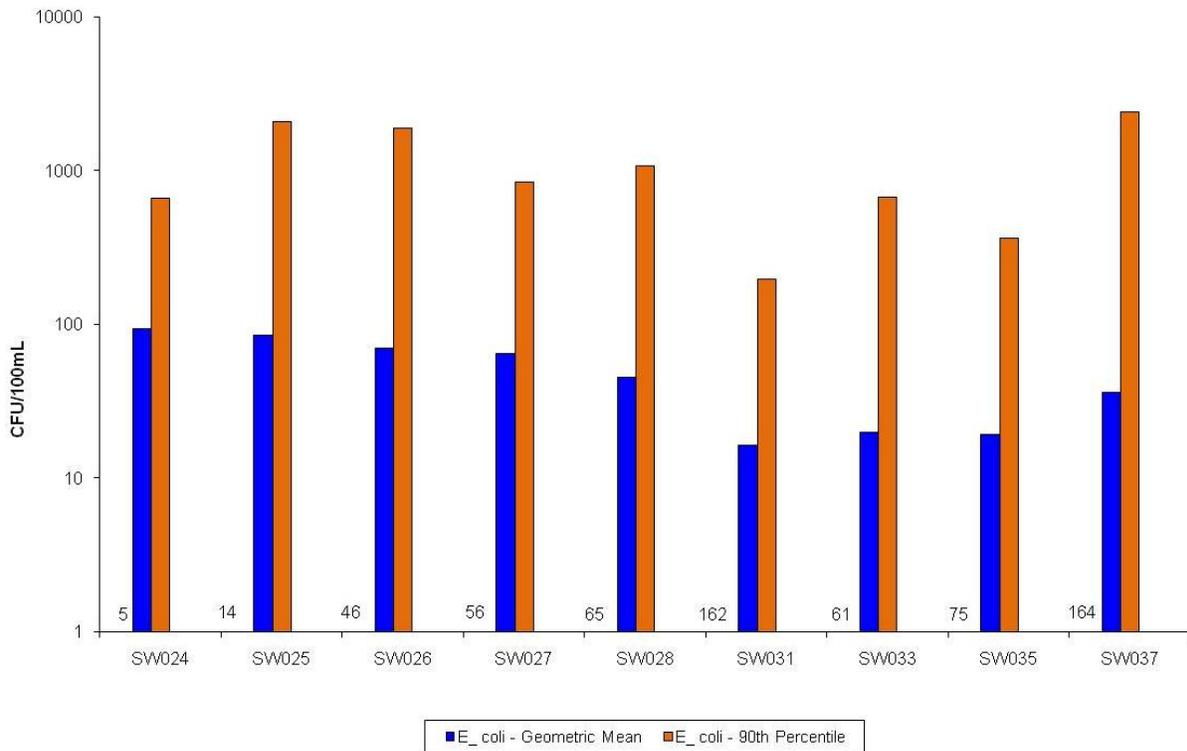


Figure 6.26 Class A Fresh Water *E.coli* Results: Period of Record through 2009

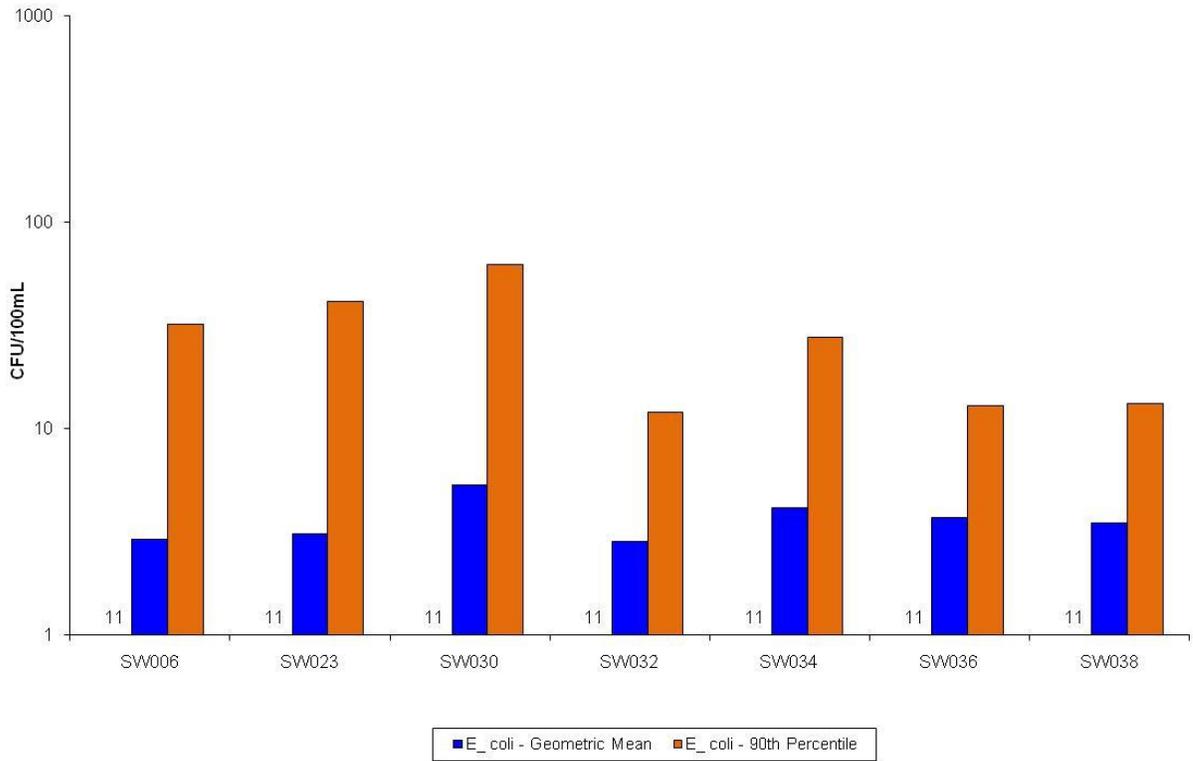


Figure 6.27 Class A Marine Water *E.coli* Bacteria Results: 2010

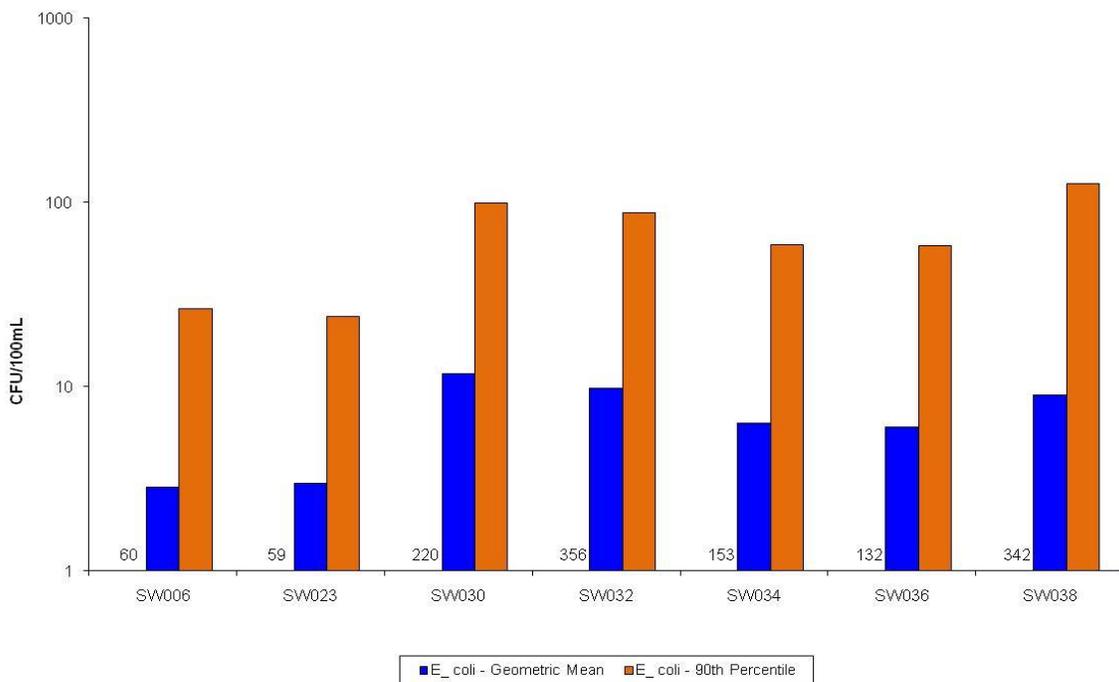


Figure 6.28 Class A Marine Water *E.coli* Bacteria Results: Period of Record through 2009

6.4. Water Temperature Results

Similar to bacteria, the standards for water temperature are set at a maximum value. If the maximum measured water temperature is greater than the water quality criteria, the sample results indicate that the characteristic uses of the water body are not fully supported. The existing sampling program collects single measurements of water temperature at all sample sites during a sampling run that typically occurs once each month. Since the water quality standards are expressed as the 7-day average of the daily maximum value in the case of fresh water sites, and the 1-day maximum temperature for marine water sites, the collected data do not allow a direct comparison with the applicable water quality standards. However, the sample results provide an indicator of whether the water quality standards were exceeded at that time. Continuous recording water temperature probes were deployed at 10 of the surface water monitoring sites during 2010. The data collected at the 10 sites with continuous temperature dataloggers will allow direct comparison with the applicable water quality standards at these sites. Due to lost equipment and access limitations of the temperature dataloggers, only six of the ten sites have a complete data set for 2010; one site has a six month continuous water temperature record.

6.4.1. Class AA Waters

The Class AA fresh water quality standard for water temperature is a 7-day average of the daily maximum value (7DADM) temperature of 16.0°C. For summer time spawning, temperature shall not exceed a 7DADM temperature of 13.0°C. As shown in Figure 6.29, the water quality data collected during 2010 suggest that this standard was exceeded at 11 of the 16 sample sites. Although sample Site SW004 is shown in Figure 6.29 to have met this standard during 2010, these results reflect the laboratory findings from only two samples. As described previously, SW004 is only sampled during flood conditions in the Nooksack River. As shown in Figure 6.29 and Figure 6.30, the water temperature was always below the standard at two of the Class AA fresh water monitoring sites (SW029 and SW004). Site SW029 is in a largely forested watershed that drains a portion of the Lummi Peninsula. As discussed earlier, Site SW004 is only sampled when the Nooksack River is flooding to the level where sampling at Site SW118 would be dangerous.

The Class AA marine standard for water temperature is a 1-day maximum temperature of 13.0°C. As shown in Figure 6.31 and Figure 6.32, the water temperature exceeded the standard at least once at all of the Class AA marine water quality monitoring sites both during 2010 and during the period of record through 2009.

As shown in Figure 6.33, the water temperature sample results for the representative Class AA fresh water site that contributes to a Class AA marine water site (SW009 on the Lummi River along the northern Reservation boundary) have generally been below the 16.0°C threshold over the period of record. In contrast, as shown in Figure 6.34, the water temperature sample results for the representative Class AA marine water site (SW002 in Lummi Bay) have commonly been above the 13.0°C threshold over the period of record. Site SW002 is located on the tide flats of Lummi Bay and the water temperature increases as the tidal waters flow over the mud flats. There is not an anthropogenic cause for the elevated temperatures at this location.

As shown in Figure 6.35, the water temperature at Site SW009 varies during the year with the highest temperatures occurring during July and August and the lowest temperatures during December and January. As shown in Figure 6.36, a similar pattern occurs at Site SW002 except that the lowest temperature occurs during February.

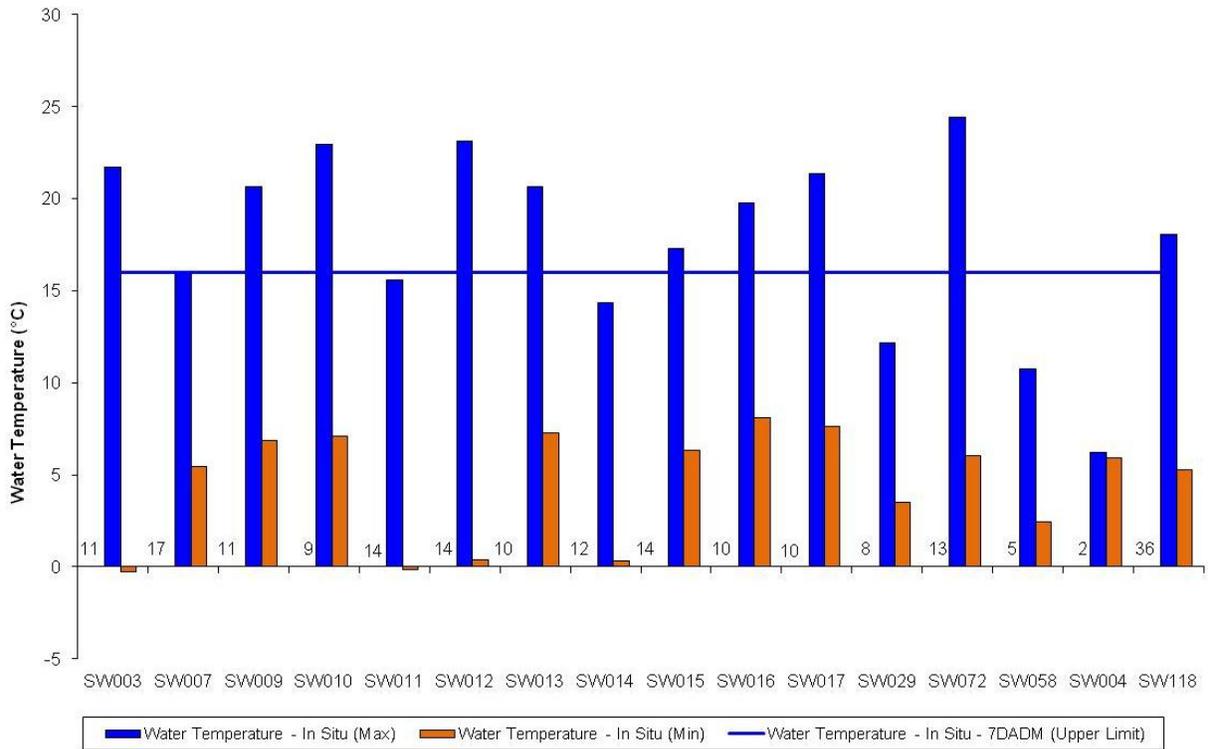


Figure 6.29 Class AA Fresh Water Temperature Results Compared with Water Quality Standards: 2010

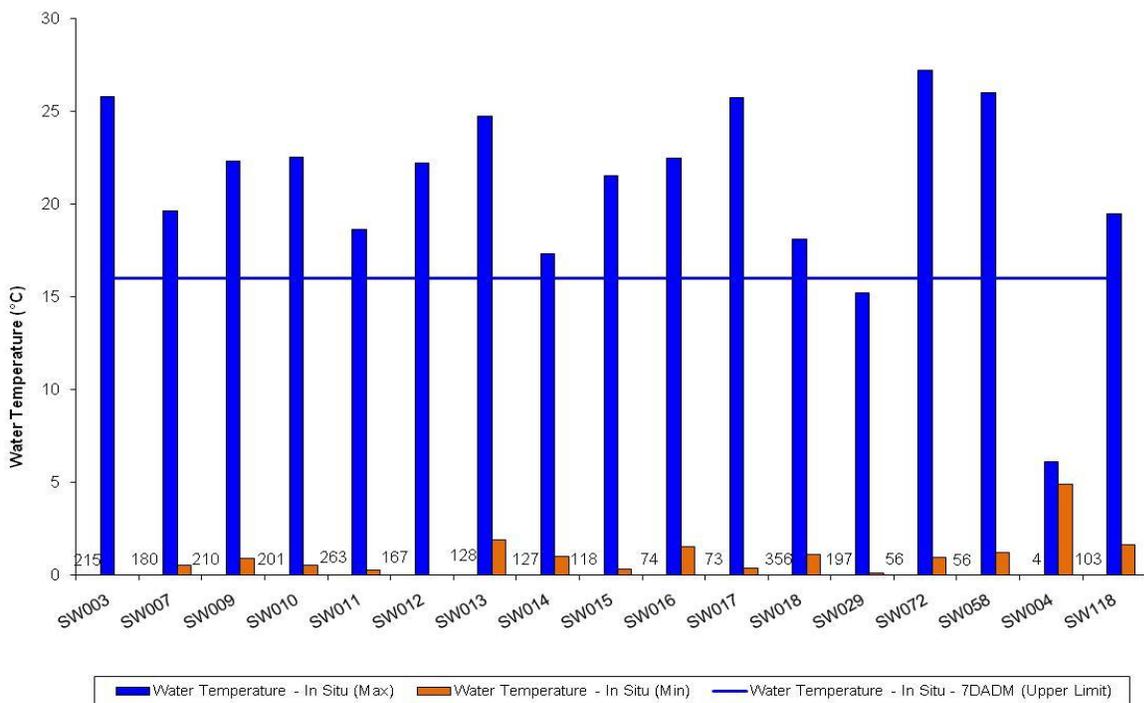


Figure 6.30 Class AA Fresh Water Temperature Results Compared with Water Quality Standards: Period of Record through 2009

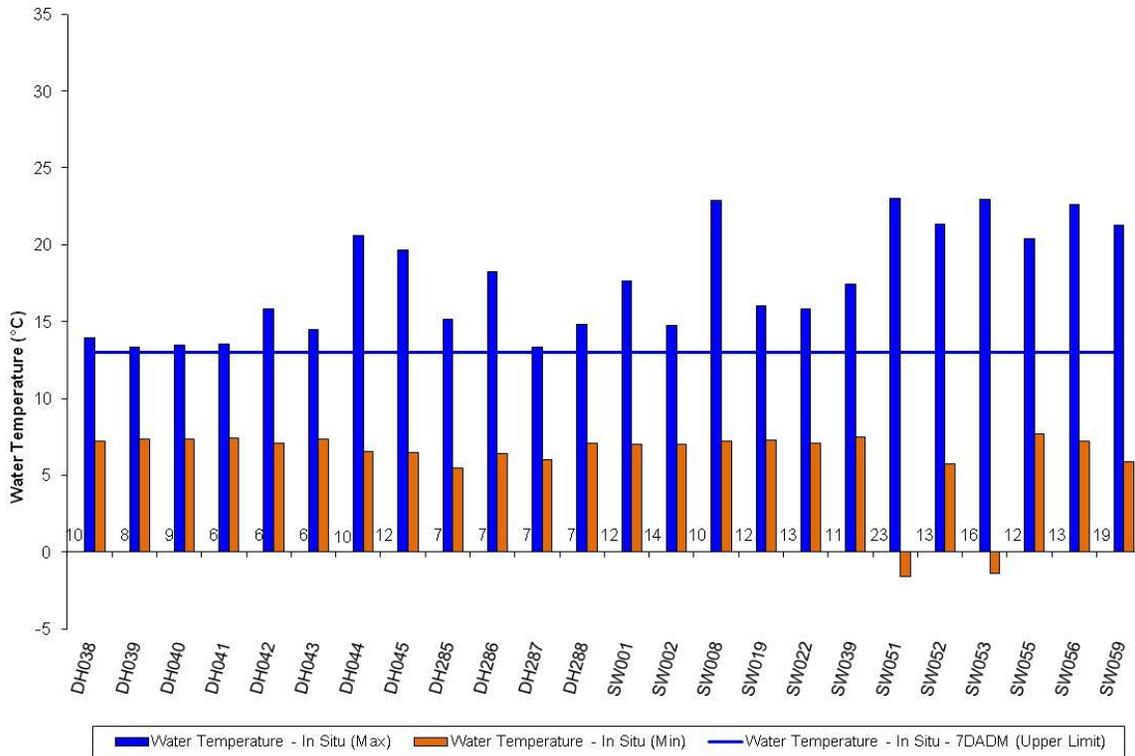


Figure 6.31 Class AA Marine Water Temperature Results Compared with Water Quality Standards: 2010

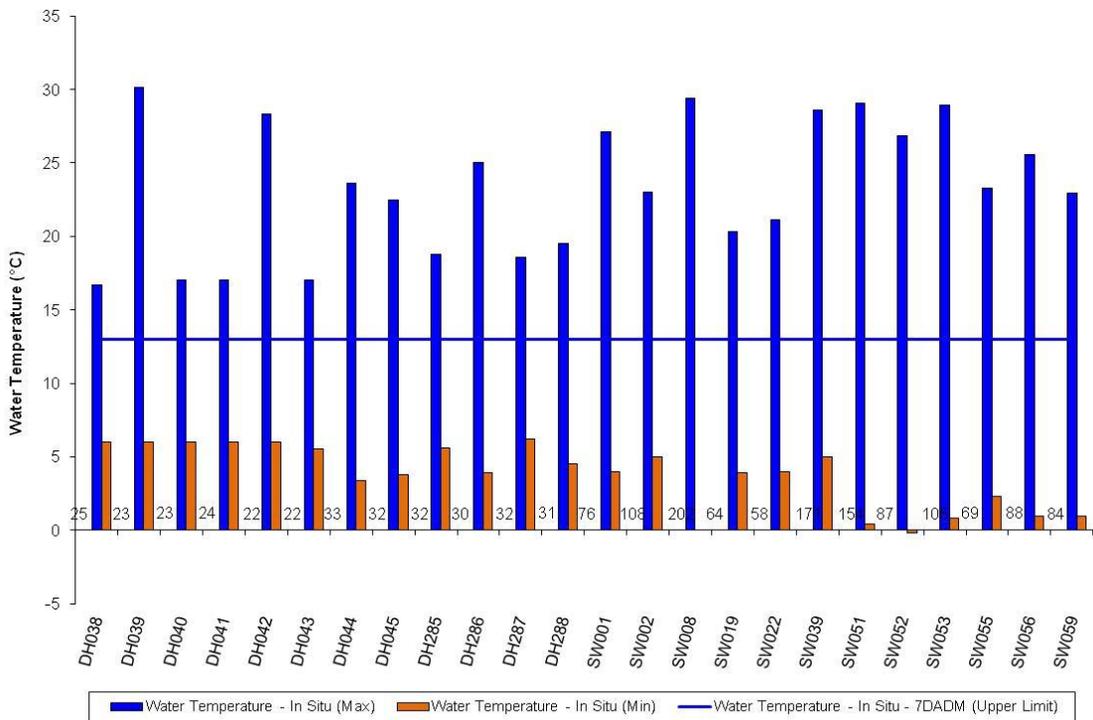


Figure 6.32 Class AA Marine Water Temperature Results Compared with Water Quality Standards: Period of Record through 2009

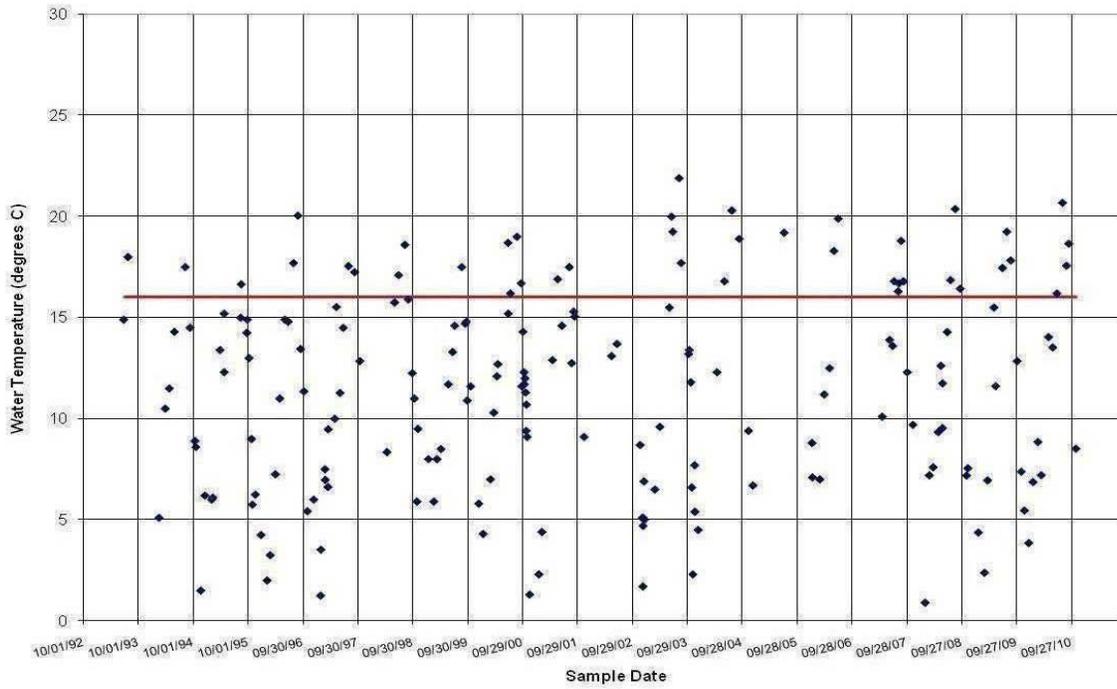


Figure 6.33 Class AA Fresh Water Temperature Results, Site SW009

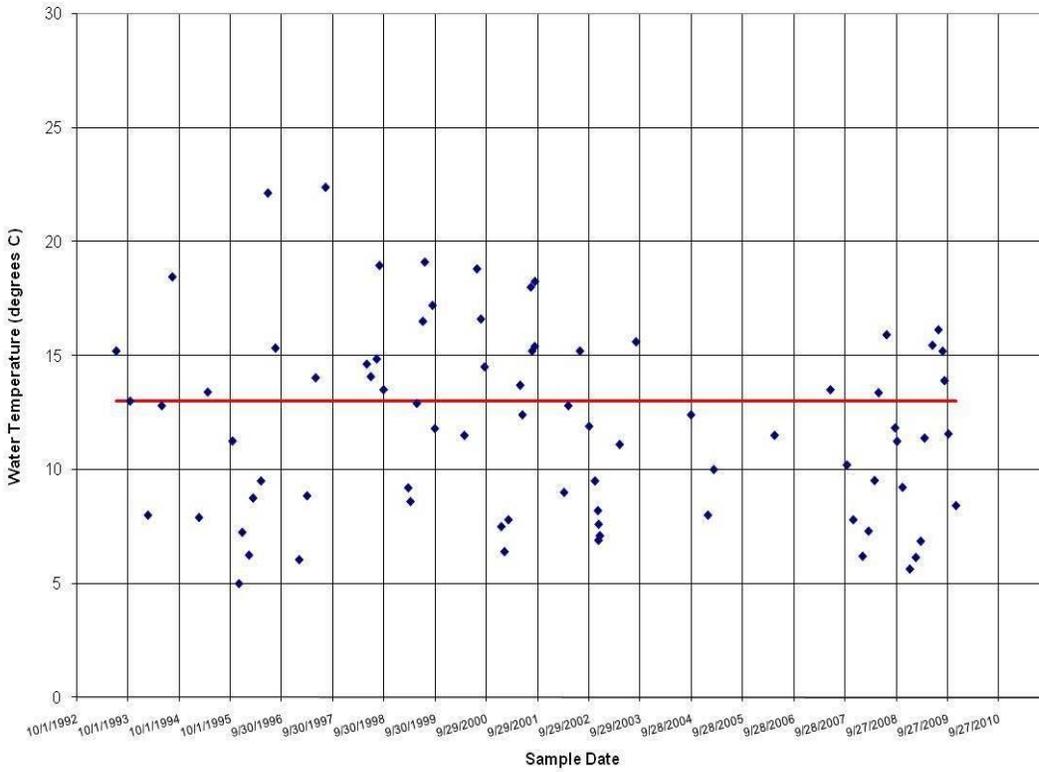


Figure 6.34 Class AA Marine Water Temperature Results, Site SW002

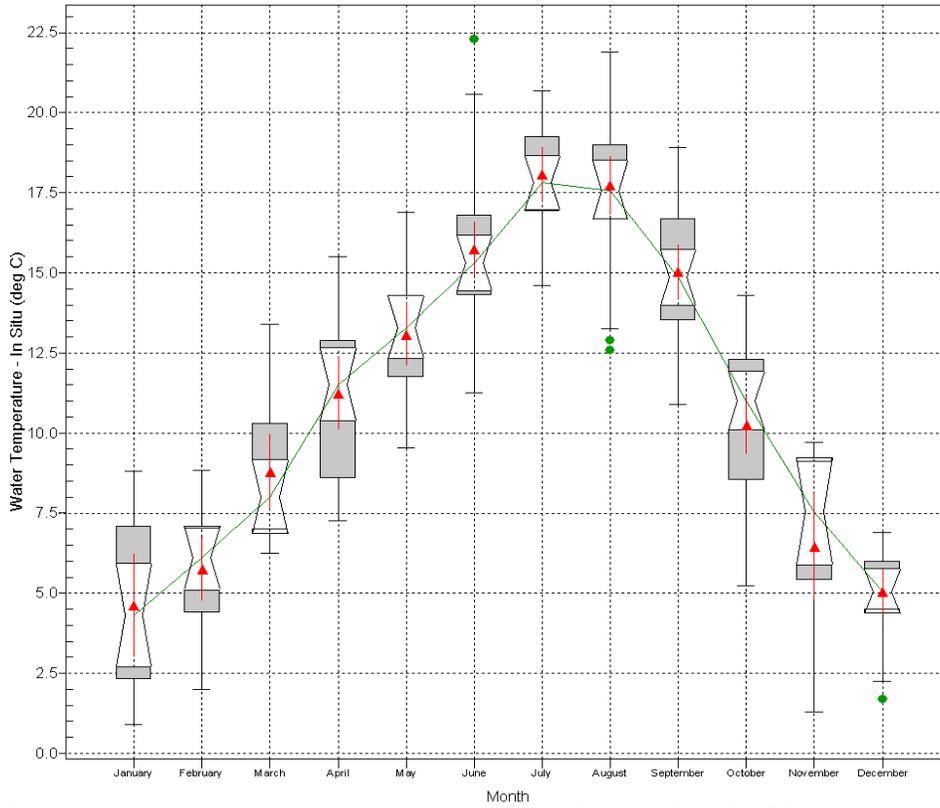


Figure 6.35 Monthly Temperature Variation for Period of Record, Site SW009

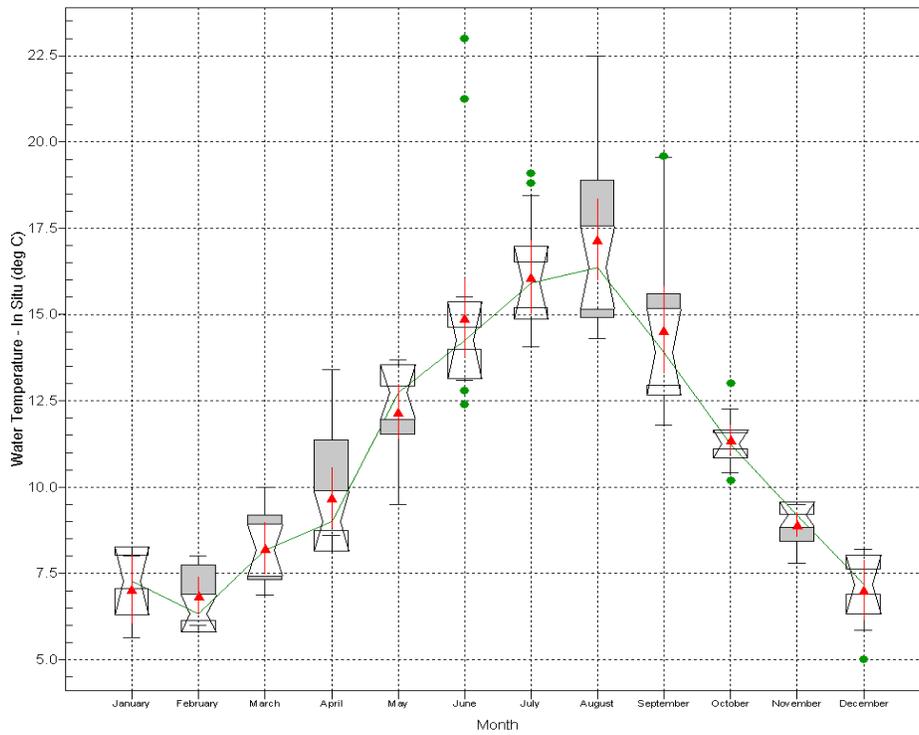


Figure 6.36 Monthly Temperature Variation for Period of Record, Site SW002

6.4.2. Class A Waters

The Class A fresh water standard for water temperature is a 7-day average of the daily maximum value (7DADM) of 17.5°C. As shown in Figure 6.37, the water quality data collected during 2010 suggest that this standard was achieved at 5 of the 8 sample sites. Although sample sites SW025, SW035, and SW037 are shown in Figure 6.37 to have met the temperature standard during 2010, these results are from only two or three samples. As shown in Figure 6.38, the water temperature was always below the standard at two of the Class A fresh water monitoring sites (SW024 and SW025). Both of these sites are in a largely forested watershed that drains a portion of Portage Island and are sites that are sampled infrequently due to limited flowing water.

The Class A marine water quality standard for water temperature is a 1-day maximum temperature of 16.0°C. As shown in Figure 6.39, the water quality collected during 2010 suggests that this standard was not achieved at any of the Class A marine water quality sample sites. As shown in Figure 6.40, the water temperature exceeded the standard at 8 of the 18 Class A marine water quality monitoring sites over the period of record through 2009.

As shown in Figure 6.41, the water temperature sample results for the representative Class AA fresh water site that contributes to a Class A marine water site (SW018 and SW118 on the Nooksack River along the Reservation boundary) have generally been below the 16.0°C Class AA threshold over the period of record. However, in the last two years water temperatures above the standard have become more frequent. As shown in Figure 6.42, the water temperature sample results for the representative Class A marine water site (SW030 in Bellingham Bay) have also generally been below the 16.0°C Class A criterion over the period of record. Site SW030 is located on the tide flats of Bellingham Bay, which at this location are not as extensive as the tide flats of Lummi Bay near Site SW002. However, similar to Site SW002, the water temperature increases as the tidal waters flow over the mud flats and there does not appear to be an anthropogenic cause for the elevated water temperatures observed at this location.

As shown in Figure 6.43, the water temperature at Site SW118 varies during the year with the highest temperatures occurring during July and August and the lowest temperatures during December through February. As shown in Figure 6.44, a similar pattern occurs at Site SW030.

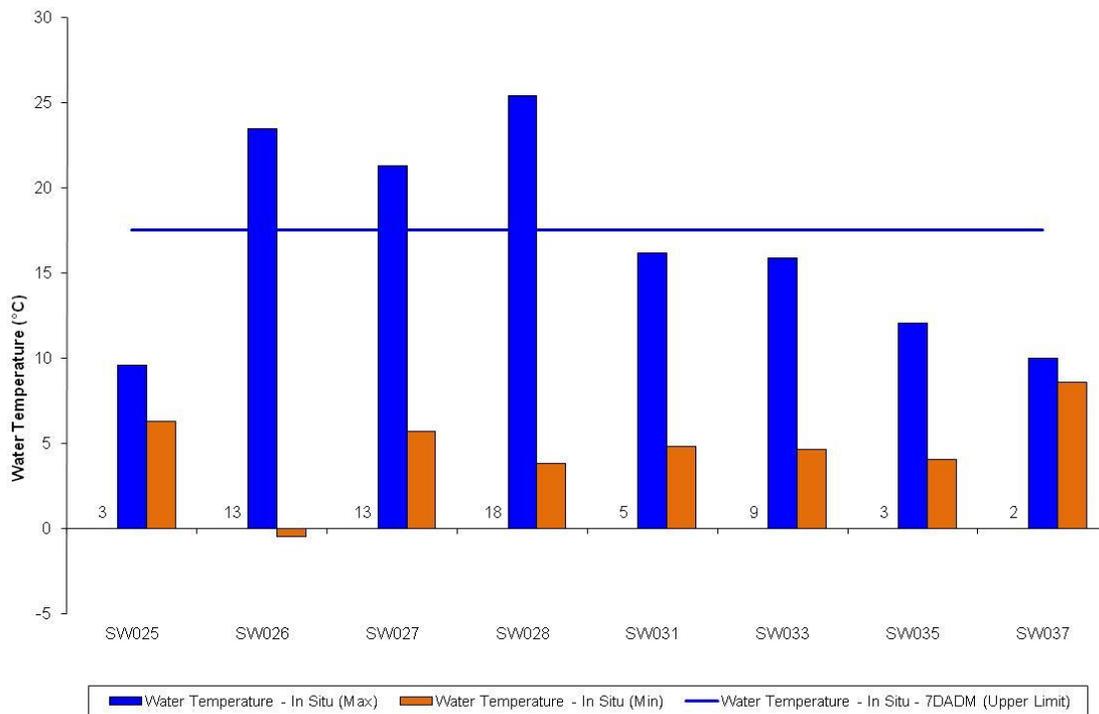


Figure 6.37 Class A Fresh Water Temperature Results Compared with Water Quality Standards: 2010

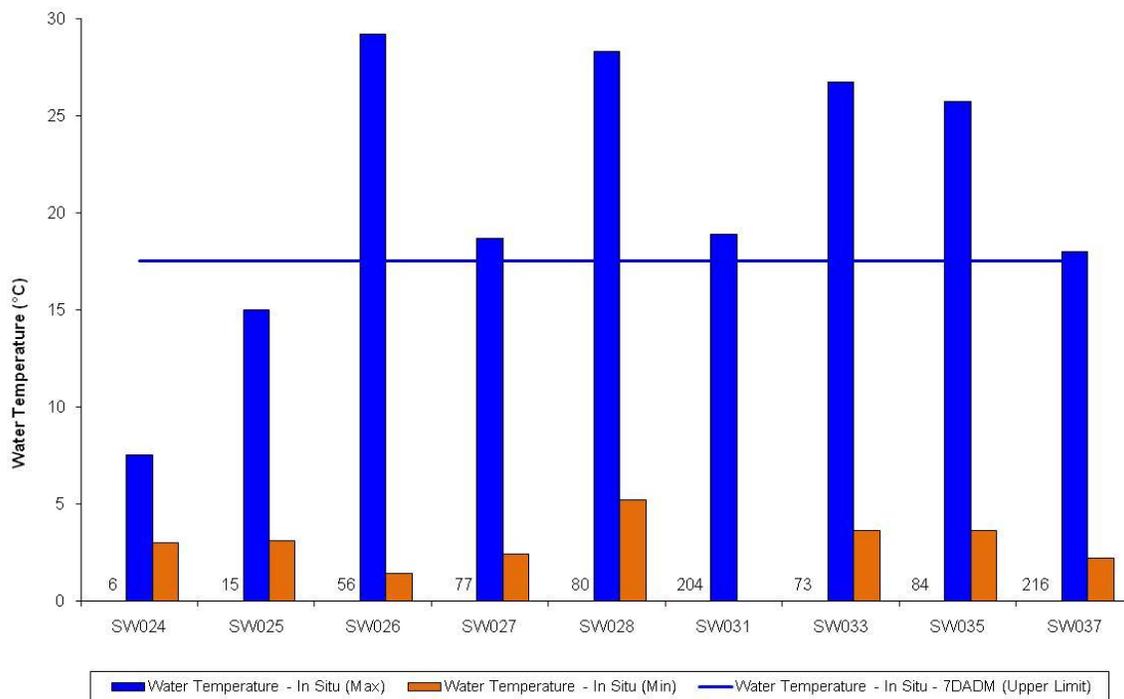


Figure 6.38 Class A Fresh Water Temperature Results Compared with Water Quality Standards: Period of Record through 2009

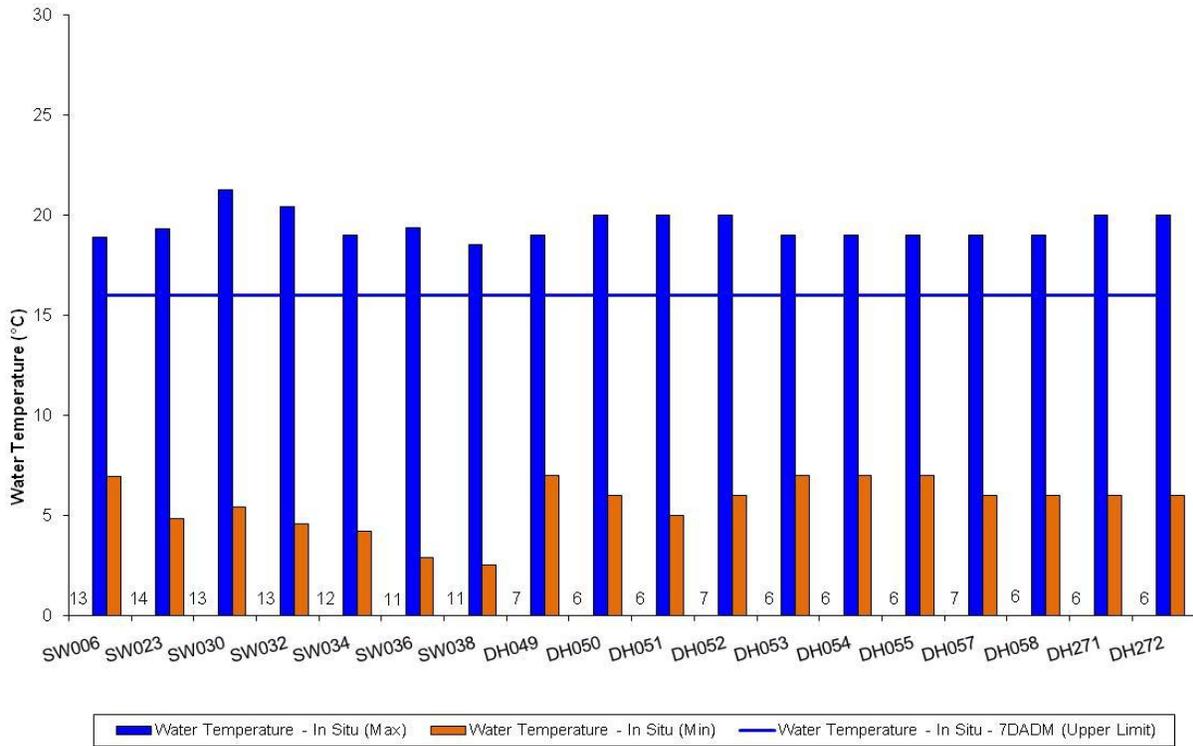


Figure 6.39 Class A Marine Water Temperature Results Compared with Water Quality Standards: 2010

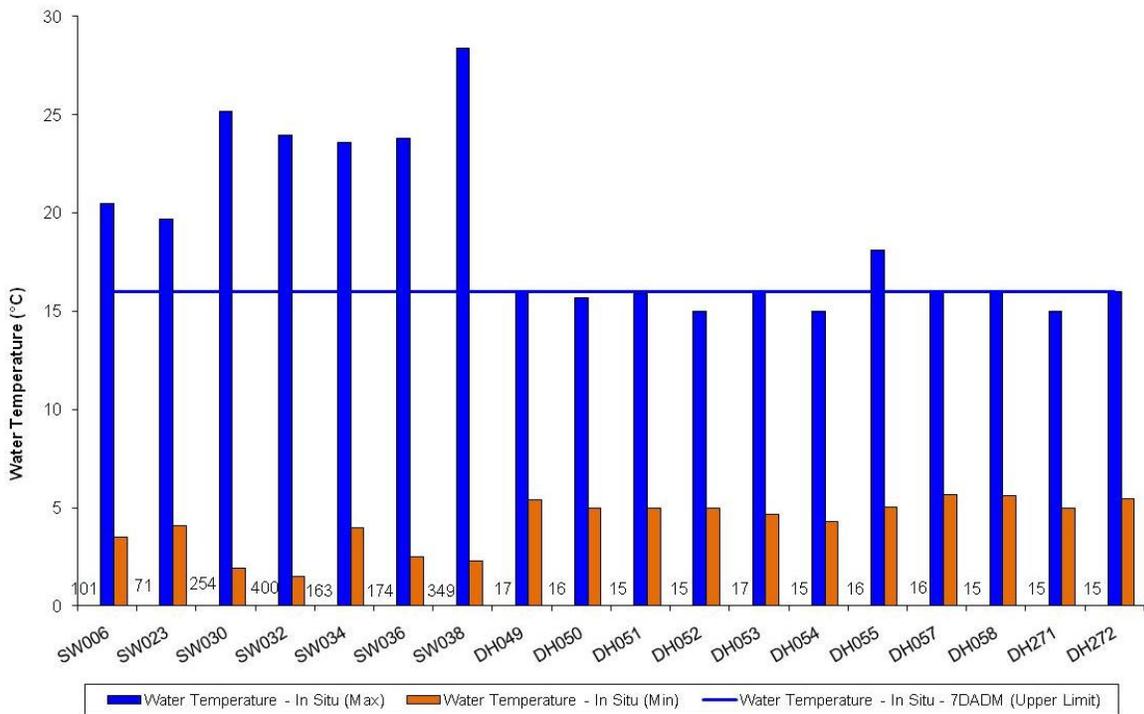


Figure 6.40 Class A Marine Water Temperature Results Compared with Water Quality Standards: Period of Record through 2009

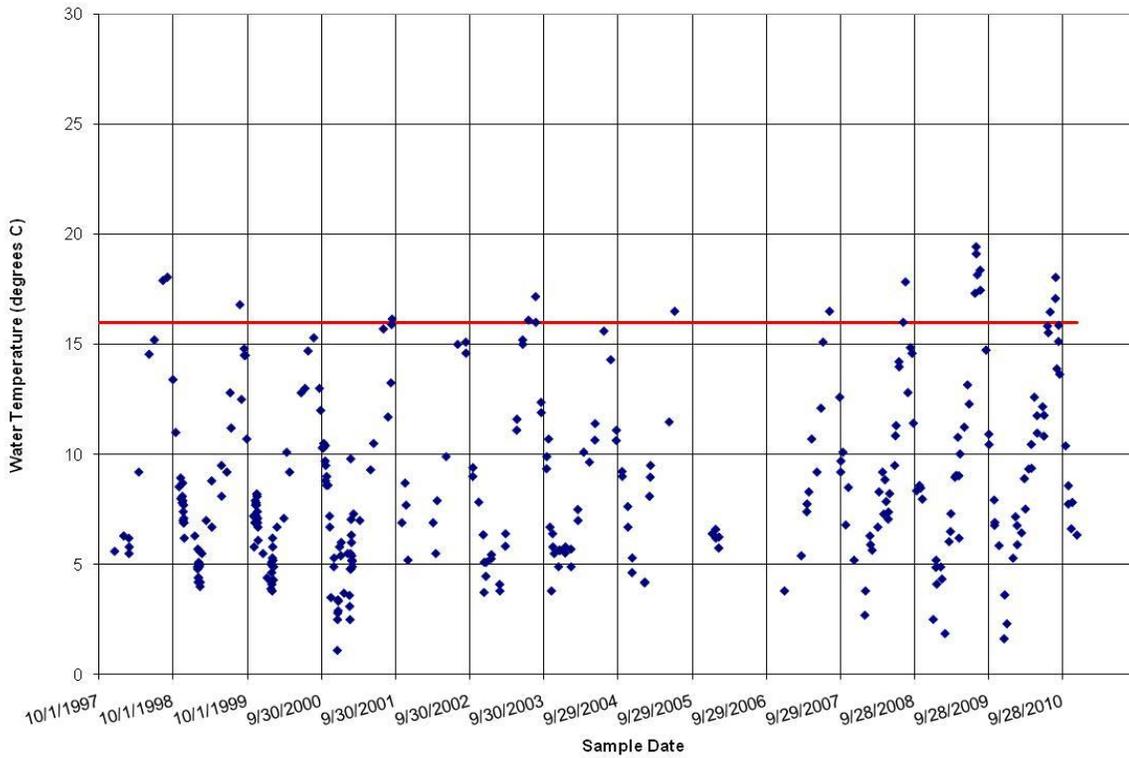


Figure 6.41 Class AA Fresh Water Temperature Results, Site SW018/SW118

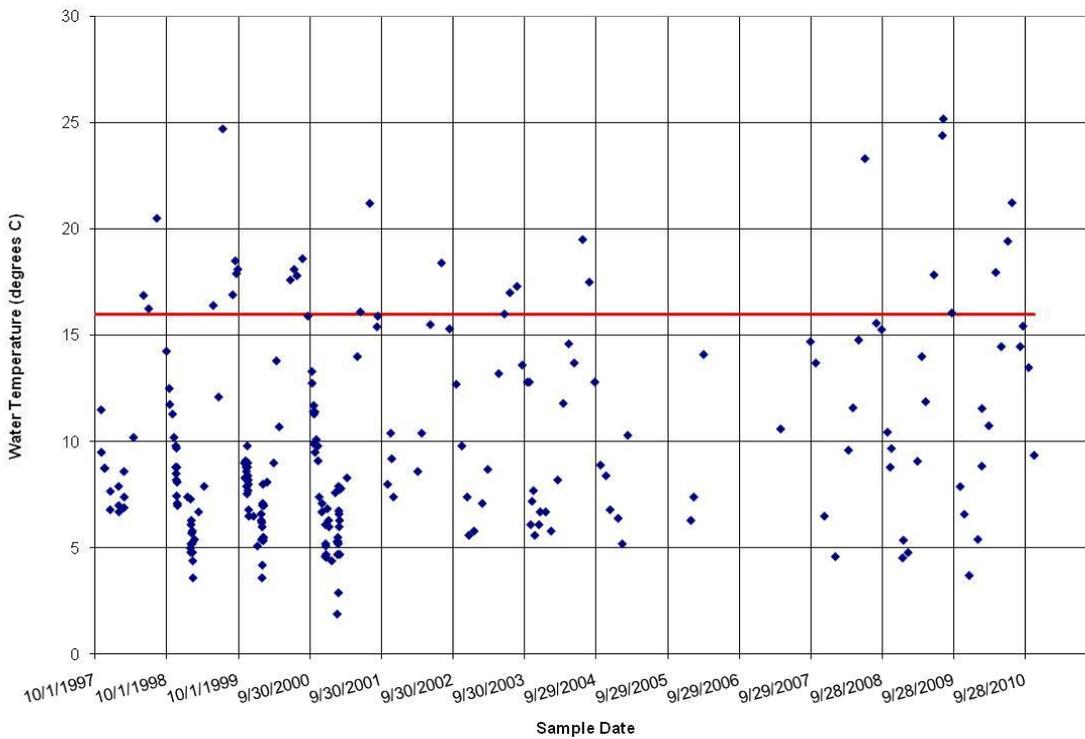


Figure 6.42 Class A Marine Water Temperature Results, Site SW030

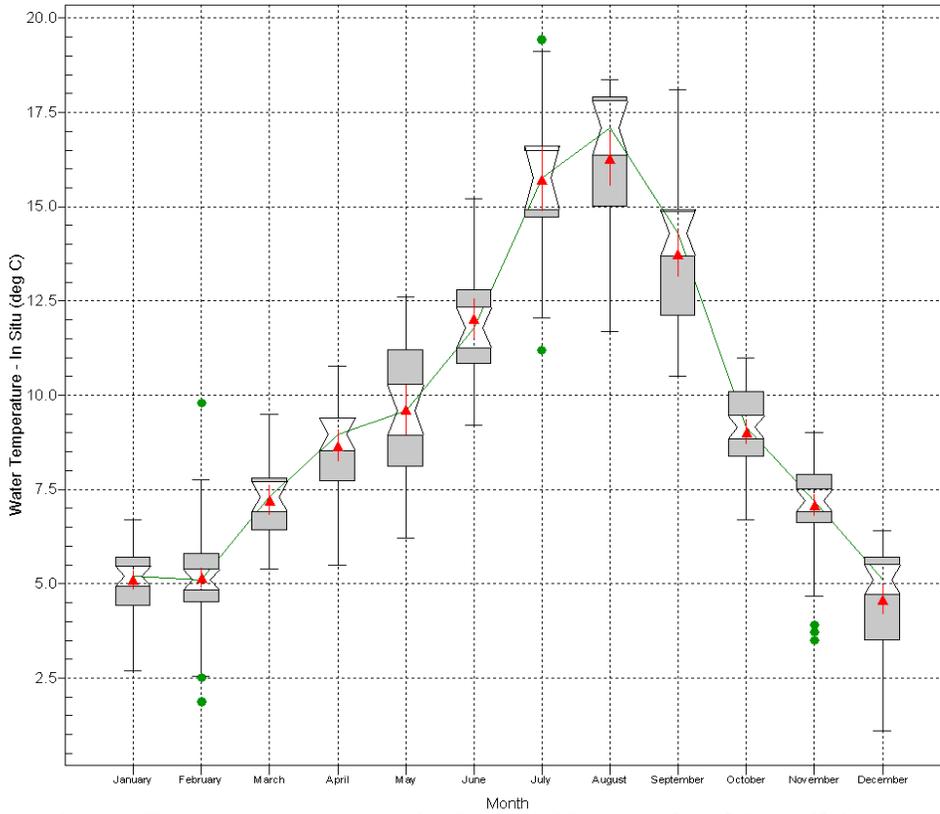


Figure 6.43 Monthly Temperature Variation for Period of Record, Site SW018/SW118

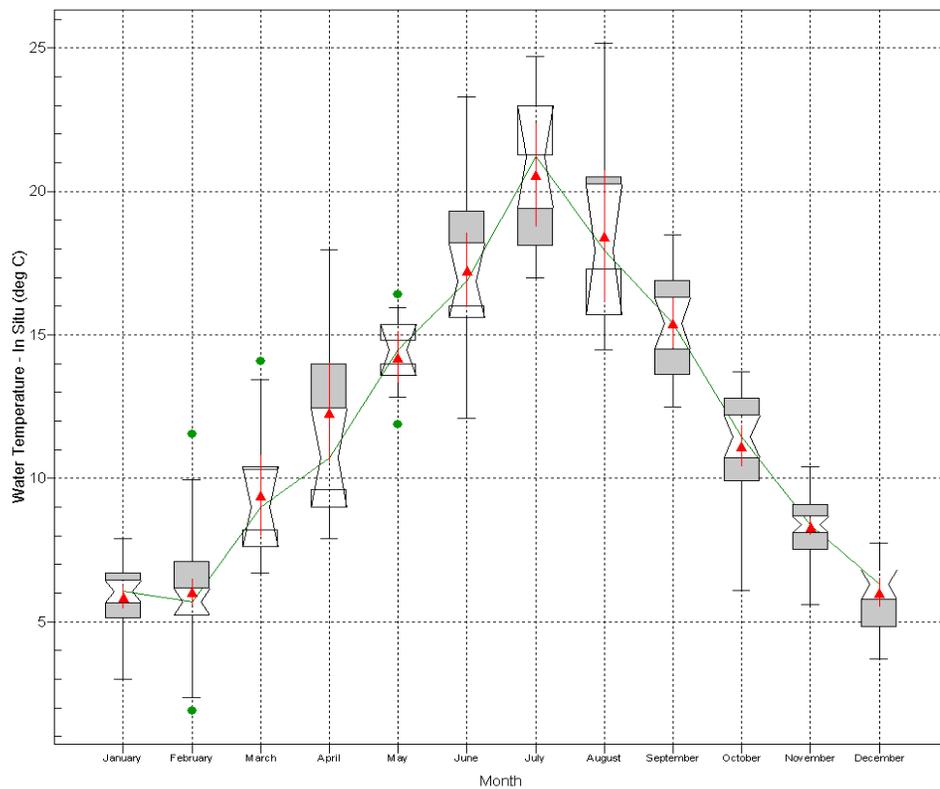


Figure 6.44 Monthly Temperature Variation for Period of Record, Site SW030

6.5. Continuous Temperature Results

The water quality standards for water temperature are established as a maximum value. If the maximum measured water temperature is greater than the water quality criteria, the characteristic uses of the water body are not fully supported. Prior to 2010, the sampling program only collected single measurements of water temperature at each site during a sampling run that typically occurs once each month. Because the water quality standards are expressed as the 7-day average of the daily maximum water temperature in the case of fresh water sites, and the 1-day maximum water temperature for marine water sites, continuous temperature monitoring is needed to accurately evaluate compliance with the standards. Continuous recording water temperature probes were deployed at 10 of the monitoring sites during 2010. Temperature is measure continuously by each probe and the average temperature is recorded every 15 minutes at each site. The temperature data are downloaded from the dataloggers on a monthly basis. The data collected at the 10 sites with continuous temperature dataloggers allows direct comparison with the applicable water quality standards. Six fresh water Class AA sites and four marine water Class AA sites were chosen in the Jordan Creek, Lummi River, Smuggler's Slough, and Nooksack River watersheds. Due to lost equipment and inaccessibility of the water temperature dataloggers, only six sites have a complete data set for 2010 and one site has six months of data.

6.5.1. Class AA Fresh Water

The Class AA fresh water quality standard for water temperature is a 7-day average of the daily maximum value (7DADM) temperature of 16.0°C. For summer time spawning, temperature shall not exceed a 7DADM temperature of 13.0°C. Continuous water temperature data were collected at the following fresh water Class AA sites during 2010:

- SW003 – Jordan Creek at North Red River Road
- SW011 – Jordan Creek at Slater Road
- SW012 – Schell Creek at Slater Road
- SW015 – Smuggler's Slough at Lummi Shore Road

As shown in Figure 6.45 through Figure 6.48, the continuous water temperature data collected during 2010 indicated that the water quality criterion was exceeded at all four sites. Site SW003 only has six months of data because the data recorder was caught in a beaver dam. The water quality standard is generally exceeded at the sites from the end of May through the beginning of October. As shown in Figure 6.46 through Figure 6.48, the highest water temperatures occurred during July and August. The lowest temperatures occurred during November and December. As shown in Figure 6.29, Site SW011 did not exceed the water temperature standard during 2010 when sampled monthly. However, as shown in Figure 6.46, Site SW011 (Jordan Creek at Slater Road) exceeded the standard for 9 weeks during 2010. As shown in Figure 6.47, sample Site SW012 (Schell Creek at Slater Road), which has lower flows than Site SW011 during the summer, exceeded the standard 18 weeks during 2010, and for two weeks in July, the 7-Day maximum was greater than 25°C.

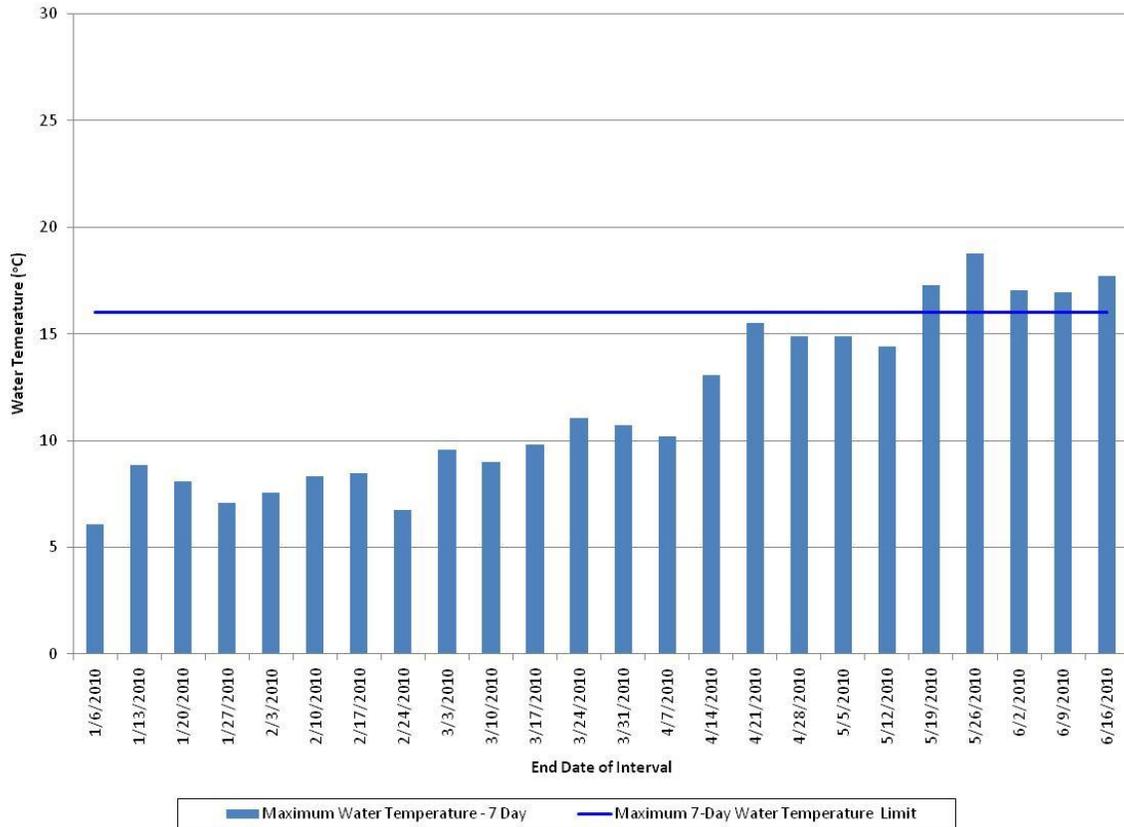


Figure 6.45 Maximum 7-Day Water Temperature Results, Site SW003

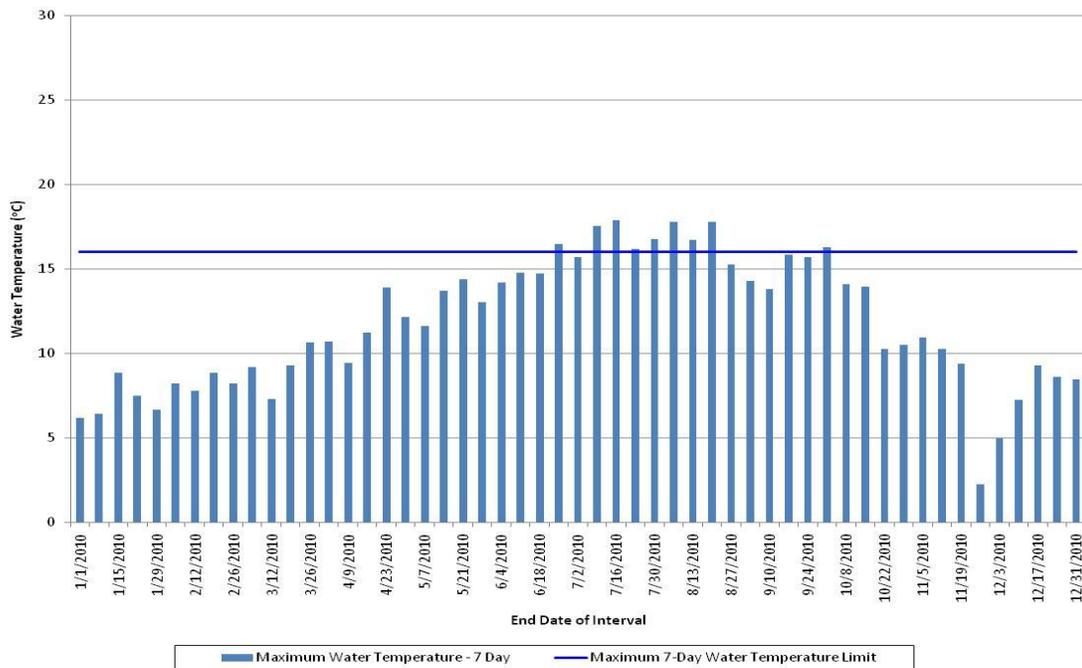


Figure 6.46 Maximum 7-Day Water Temperature Results, Site SW011

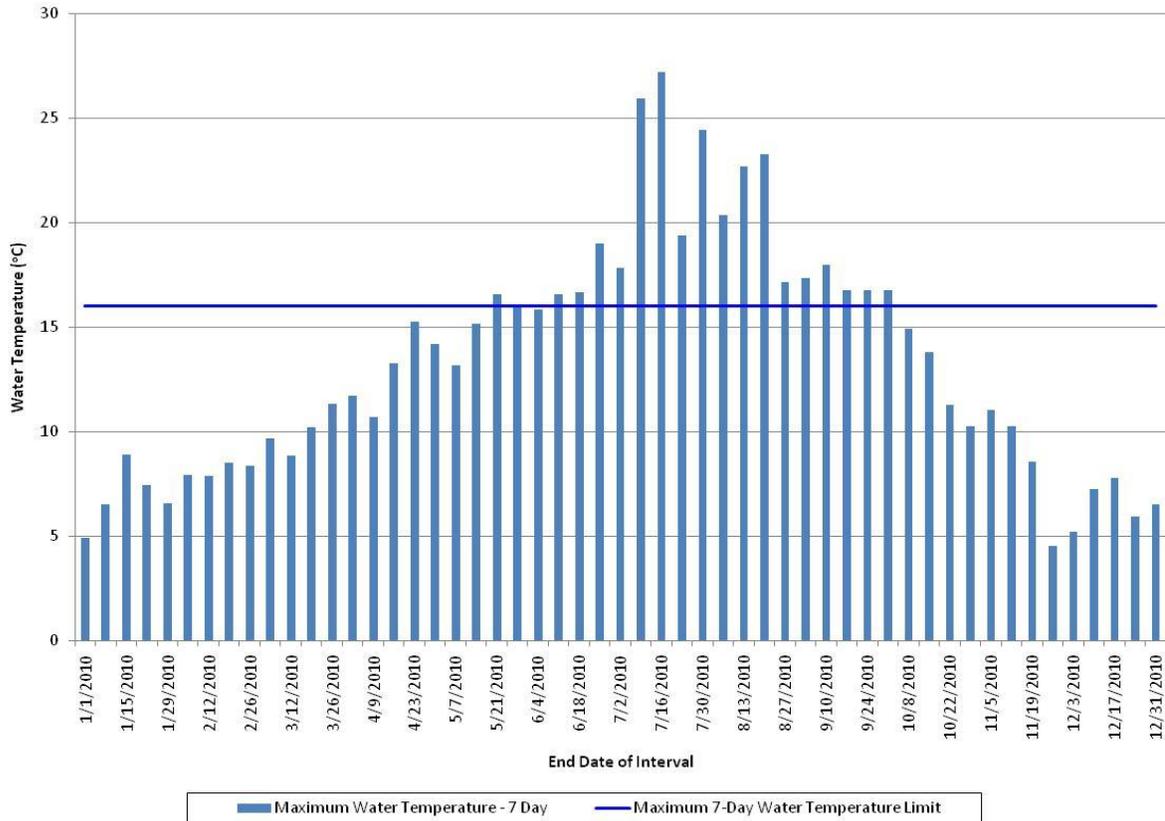


Figure 6.47 Maximum 7-Day Water Temperature Results, Site SW012

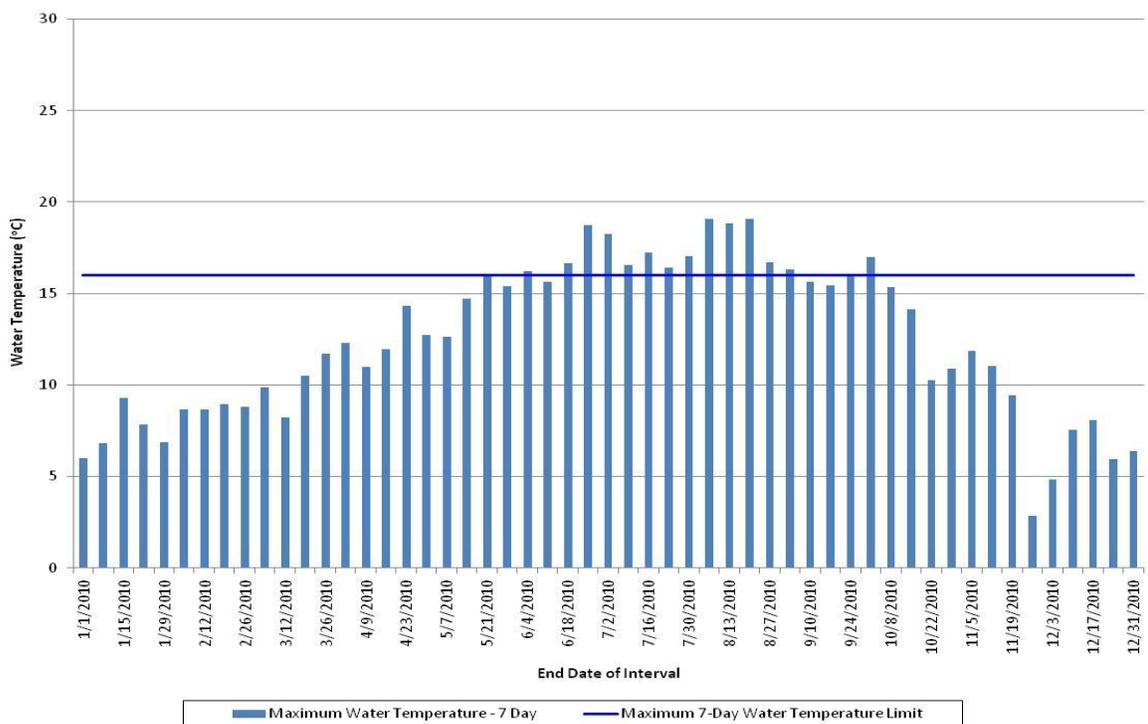


Figure 6.48 Maximum 7-Day Water Temperature Results, Site SW015

6.5.2. Class AA Marine Water

The Class AA marine water standard for water temperature is a 1-day maximum temperature of 13.0°C. Continuous water temperature data were collected at the following marine water Class AA sites during 2010:

- SW051 – Lummi River mouth
- SW053 – Jordan Creek mouth
- SW059 – Smuggler’s Slough at Kwina Road

As shown in Figure 6.49 through Figure 6.51, the water temperature exceeded the standard at all of the Class AA marine continuous water temperature monitoring sites during 2010. Similar to the Class AA fresh water sites, the water quality standard is exceeded at the Class AA marine water sites from the end of May through the beginning of October. As shown in Figure 6.49 through Figure 6.51, the highest temperatures occurred during July and August and lowest temperatures occurred during November and December. Site SW059 (Smuggler’s Slough at Kwina Road), which has the most tree cover of all the marine sites, had water temperatures always below 21°C. Whereas Site SW051 (Lummi River mouth) and Site SW053 (Jordan Creek mouth), which are both tidally influence and sampled near the tide flats of Lummi Bay, had a 1-Day maximum greater than 30°C in July 2010. The sites further downstream (SW051, SW053, and SW059) in the watersheds have higher temperatures during the summer months than those sample sites located upstream.

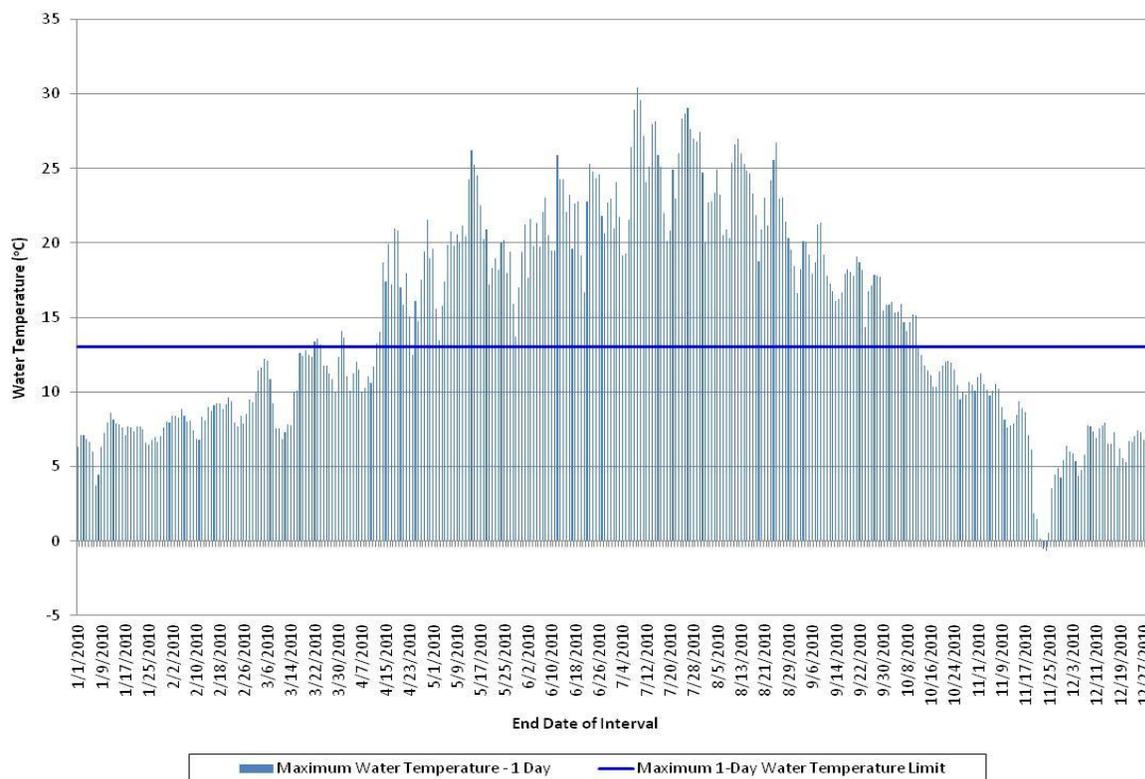


Figure 6.49 Maximum 1-Day Water Temperature Results, Site SW051

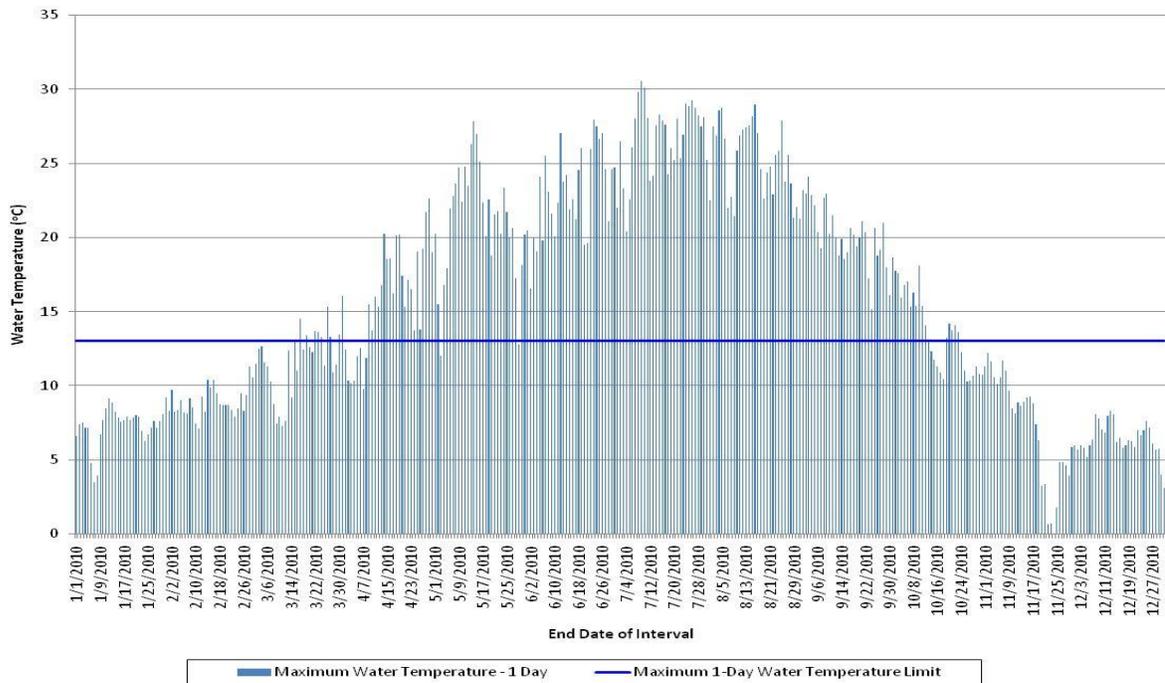


Figure 6.50 Maximum 1-Day Water Temperature Results, Site SW053

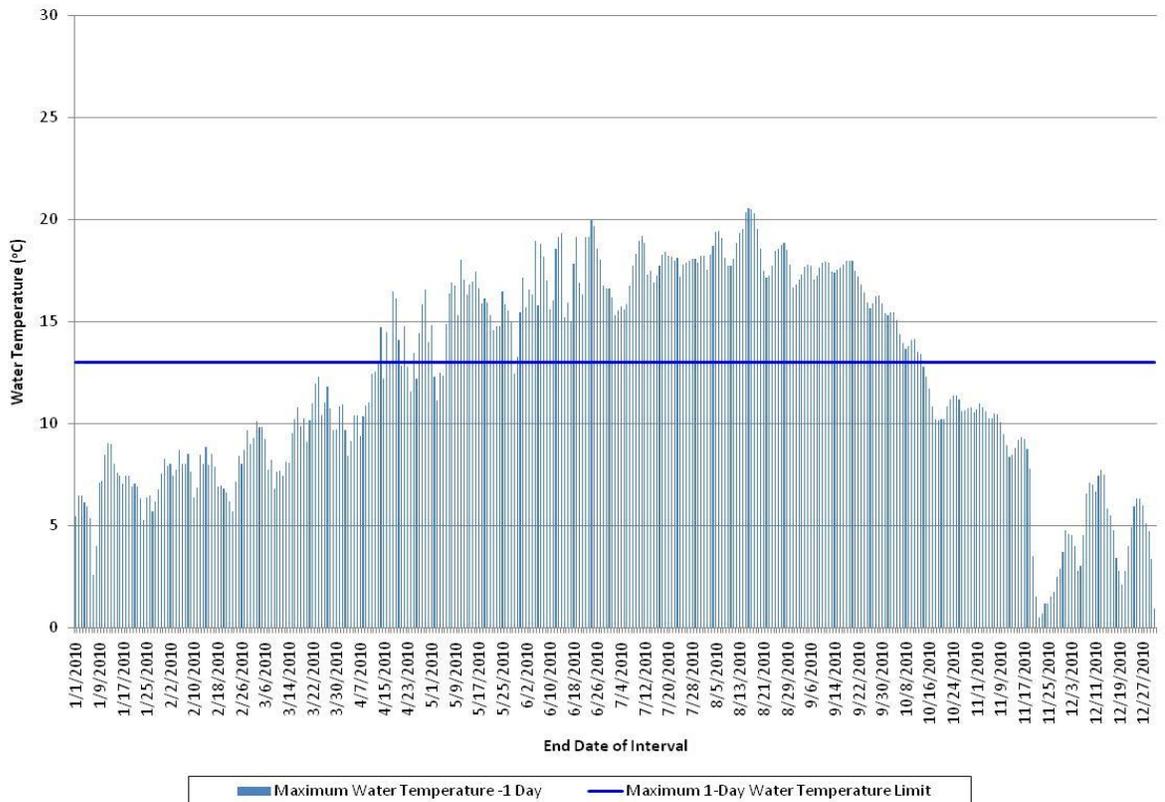


Figure 6.51 Maximum 1-Day Water Temperature Results, Site SW059

6.6. Dissolved Oxygen Results

In contrast to the bacteria and water temperature criteria, the water quality standards for dissolved oxygen are a minimum value. If the maximum or minimum measured dissolved oxygen levels are less than the water quality standard, the sample results indicate that the characteristic uses of the water body are not supported. The spatial median intergravel dissolved oxygen concentration is currently not measured at the sample sites so it is not possible to determine compliance with the water quality standards for Class AA fresh water sites.

6.6.1. Class AA Waters

The Class AA fresh water quality standard for dissolved oxygen is a minimum of 11.0 mg/l and a spatial median intergravel dissolved oxygen concentration greater than 8.0 mg/l. The spatial median intergravel dissolved oxygen concentration is currently not measured at the sample sites so it is not possible to determine compliance with the water quality standards for Class AA fresh water sites. As shown in Figure 6.52, the water quality data collected during 2010 indicate that the 11.0 mg/l part of the standard was achieved at least once for 9 of the 16 sample sites and not achieved at the three remaining sites. Although Site SW004 is shown in Figure 6.52 to have met the dissolved oxygen standard during 2010, this result is from only two samples. As shown in Figure 6.53, the dissolved oxygen levels have been above the 11.0 mg/l criterion at least once at every site except for Site SW072, where dissolved oxygen has never been measured above the 11.0 mg/l criterion. Site SW072 is a remnant of a slough in the Nooksack River/Lummi River floodplain.

The Class AA marine water quality standard for dissolved oxygen is a 1-day minimum daily concentration of 7.0 mg/l. As shown in Figure 6.54, the water quality data collected during 2010 suggest that this standard was achieved at least once at all 24 of the sample sites. During 2010, 16 of the 24 sample sites were consistently above the standard. As shown in Figure 6.55, the dissolved oxygen standard was consistently achieved over the period of record at Site SW039 (along Hale Passage) and DH038 (Lummi Bay) of the Class AA marine water monitoring sites.

As shown in Figure 6.56, the dissolved oxygen sample results for the representative Class AA fresh water site that contributes to a Class AA marine water site (SW009) have generally been below the minimum 11.0 mg/l criterion over the period of record. In contrast, as shown in Figure 6.57, the dissolved oxygen sample results for the representative Class AA marine water site (SW002) have generally been above the 7.0 mg/l criterion over the period of record.

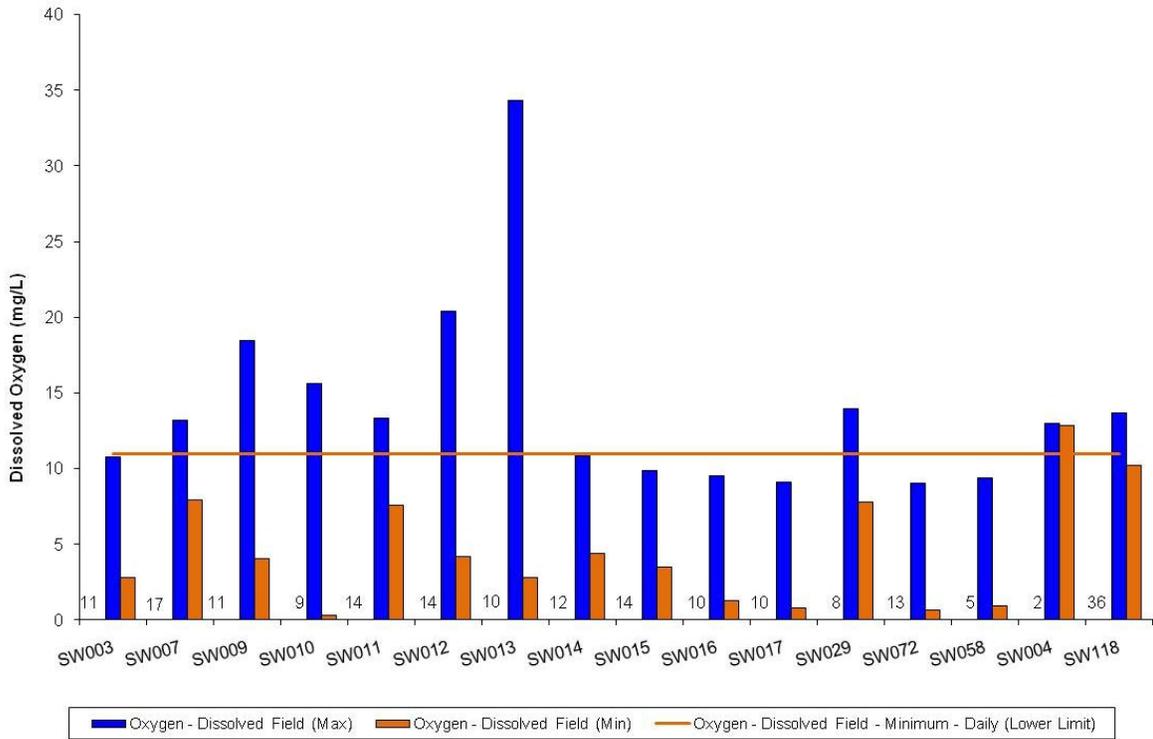


Figure 6.52 Class AA Fresh Water Dissolved Oxygen Results Compared with Water Quality Standards: 2010

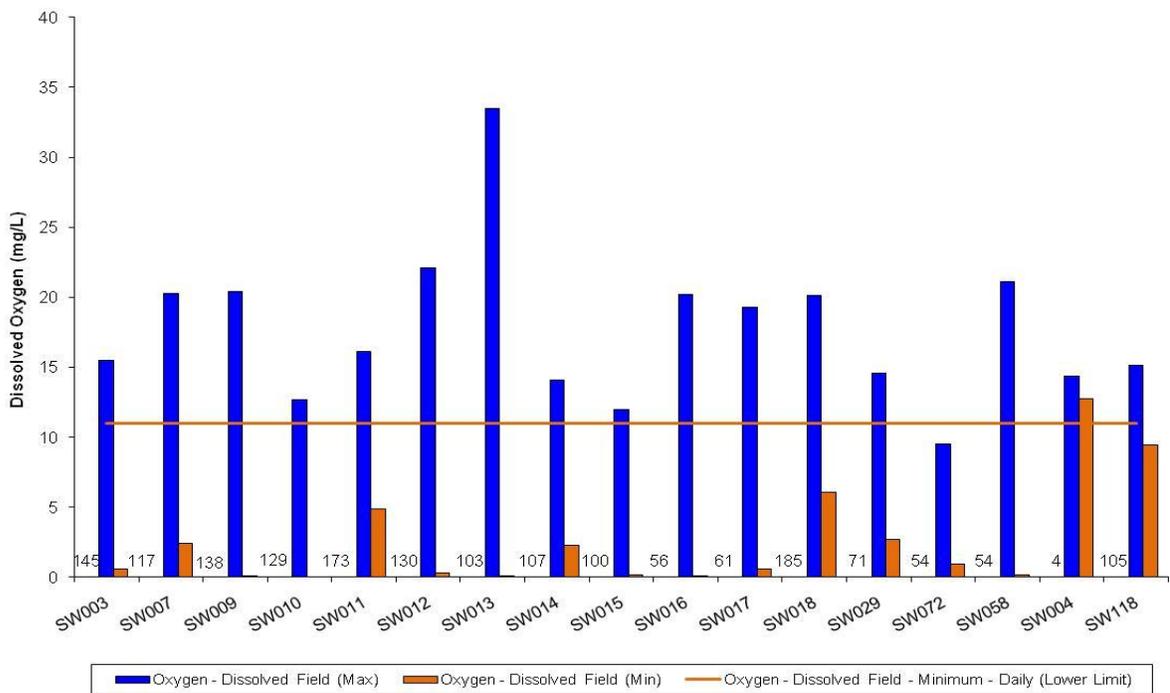


Figure 6.53 Class AA Fresh Water Dissolved Oxygen Results Compared with Water Quality Standards: Period of Record through 2009

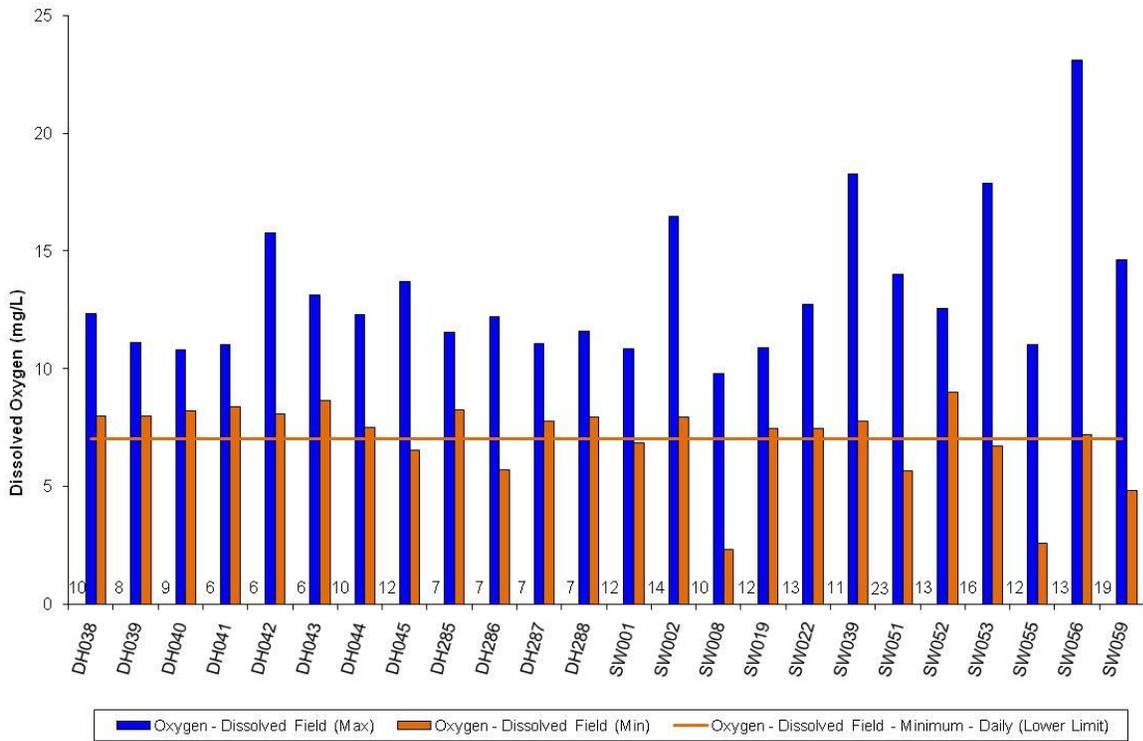


Figure 6.54 Class AA Marine Water Dissolved Oxygen Results Compared with Water Quality Standards: 2010

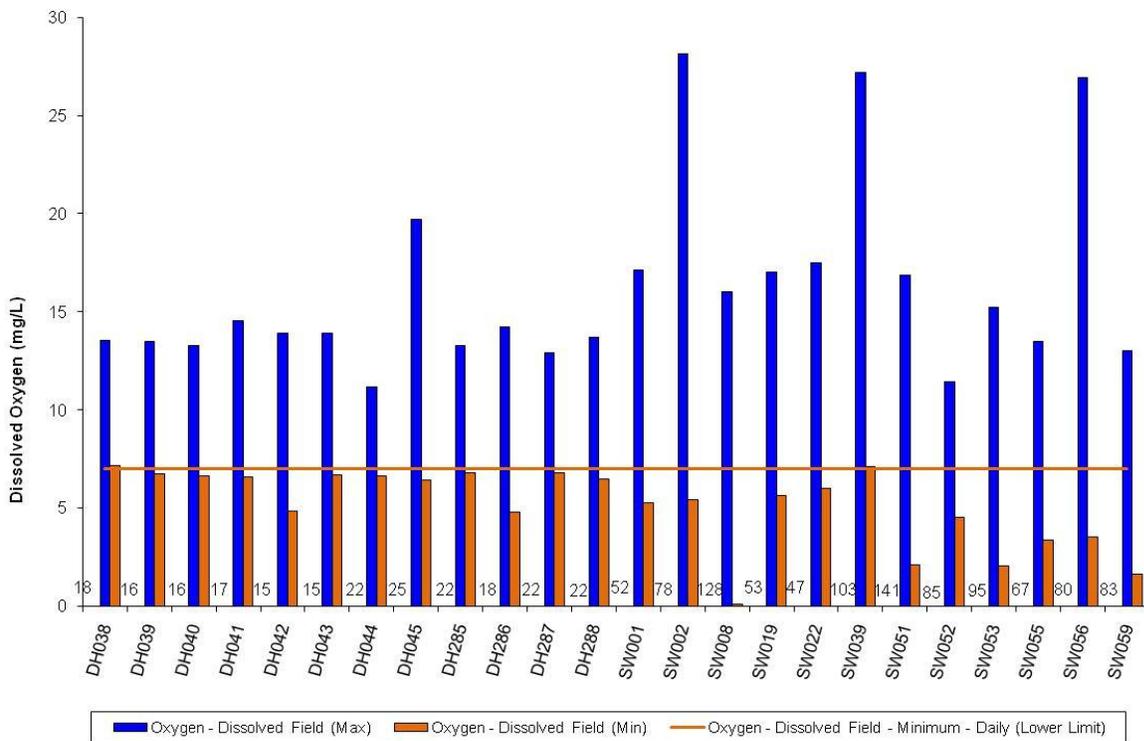


Figure 6.55 Class AA Marine Water Dissolved Oxygen Results Compared with Water Quality Standards: Period of Record through 2009

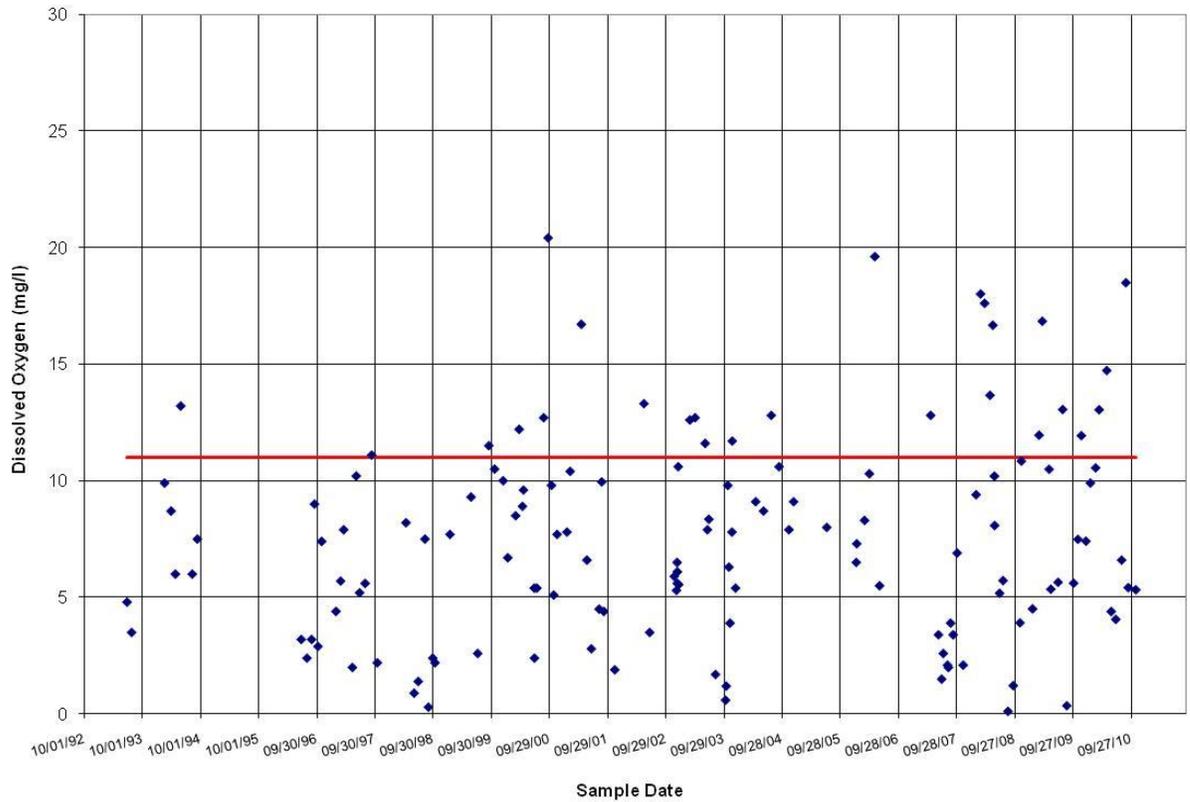


Figure 6.56 Class AA Fresh Water Dissolved Oxygen Results, Site SW009

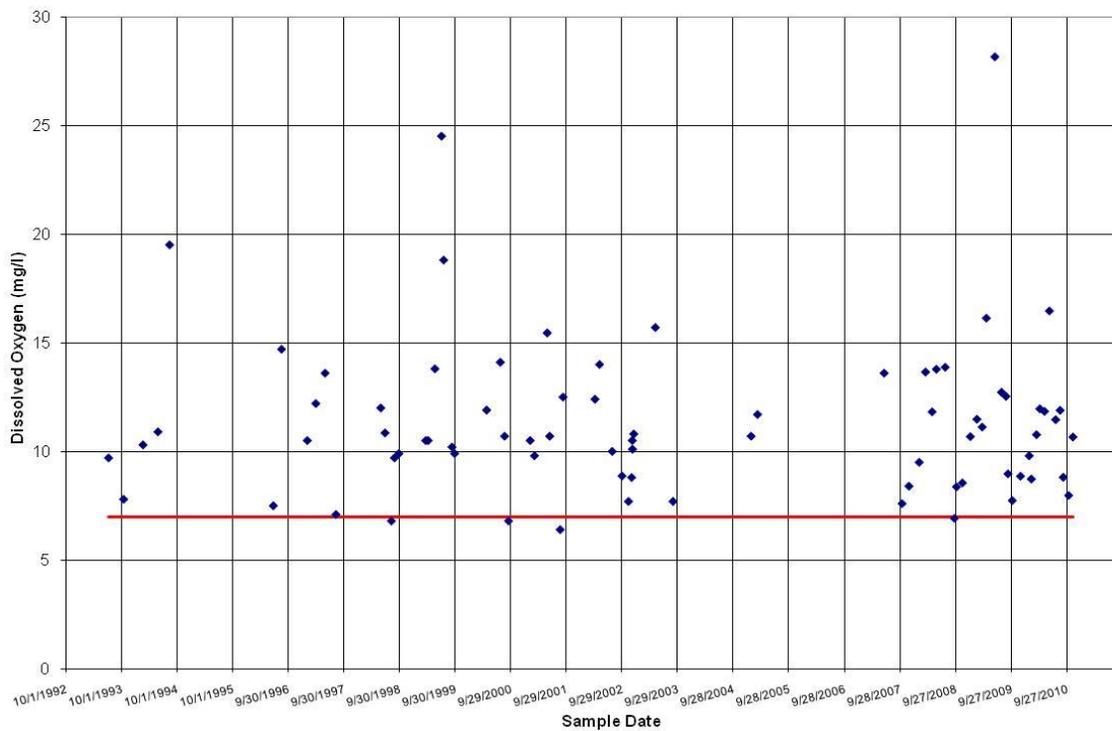


Figure 6.57 Class AA Marine Water Dissolved Oxygen Results, Site SW002

6.6.2. Class A Waters

The Class A fresh water quality standard for dissolved oxygen is a minimum value of 8.0 mg/l. As shown in Figure 6.58, the water quality samples collected during 2010 suggest that this standard was achieved at 4 of the 8 sample sites. Although sites SW025, SW035, and SW037 are shown in Figure 6.58 to have met the standard, the results were from only two or three samples at each site. As shown in Figure 6.59, the dissolved oxygen was above the minimum standard at least one time at each of the nine Class A fresh water monitoring sites over the period of record through 2009. Although Site SW024 is shown to have met the standard during the period of record, but this result reflects only two samples.

The Class A marine water quality standard for dissolved oxygen is a 1-day minimum concentration of 6.0 mg/l. As shown in Figure 6.60, the dissolved oxygen levels were consistently above the 6.0 mg/l criterion during 2010 at all seven sites. As shown in Figure 6.61, the dissolved oxygen levels consistently exceeded the standard at all of the Class A marine water quality monitoring sites except Site SW030 over the period of record through 2009.

As shown in Figure 6.62, the dissolved oxygen sample results for the representative Class AA fresh water site that contributes to a Class A marine water site (SW018 and SW118 on the Nooksack River along the Reservation boundary) have generally been above the minimum 11.0 mg/l Class AA threshold over the period of record. As shown in Figure 6.63, all the dissolved oxygen sample results except one in 2008 for the representative Class A marine water site (SW030 in Bellingham Bay) were above the minimum 6.0 mg/l Class A threshold over the period of record.

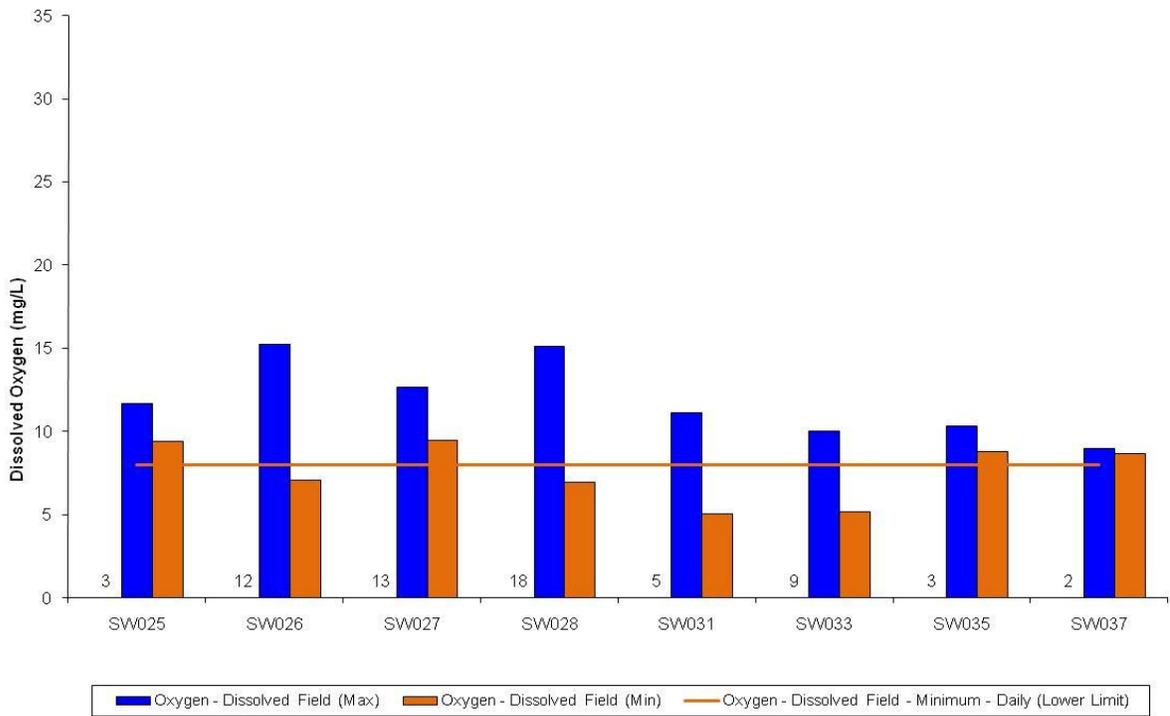


Figure 6.58 Class A Fresh Water Dissolved Oxygen Results Compared With Water Quality Standards: 2010

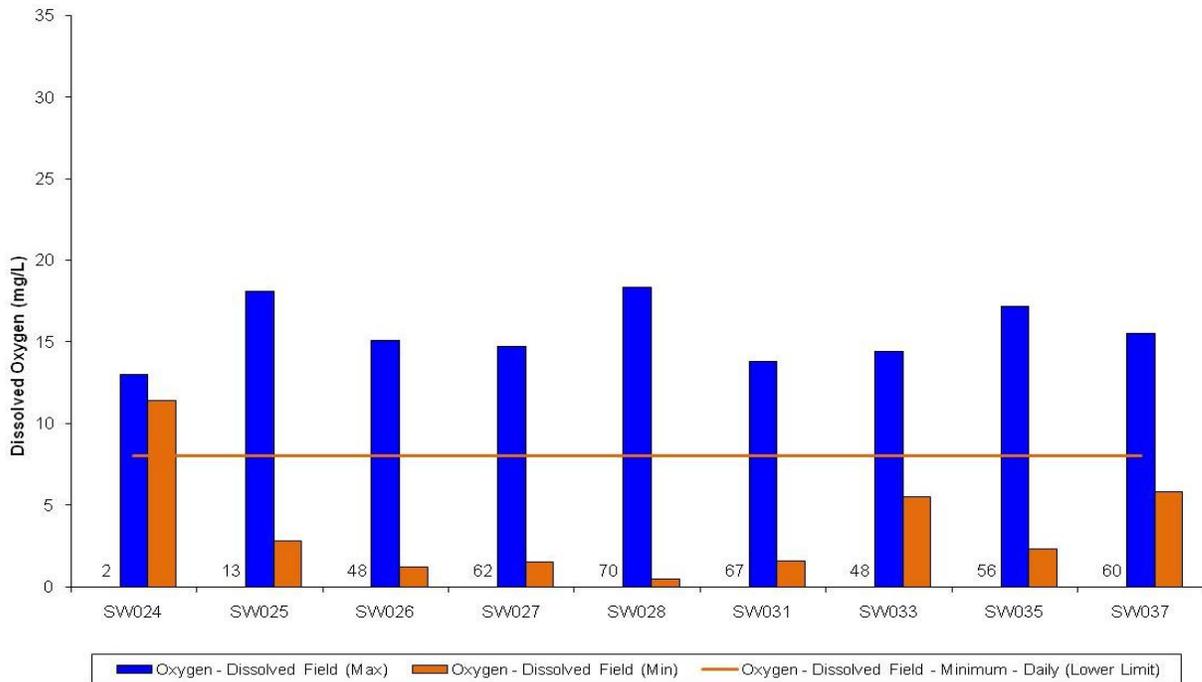


Figure 6.59 Class A Fresh Water Dissolved Oxygen Results Compared with Water Quality Standards: Period of Record through 2009

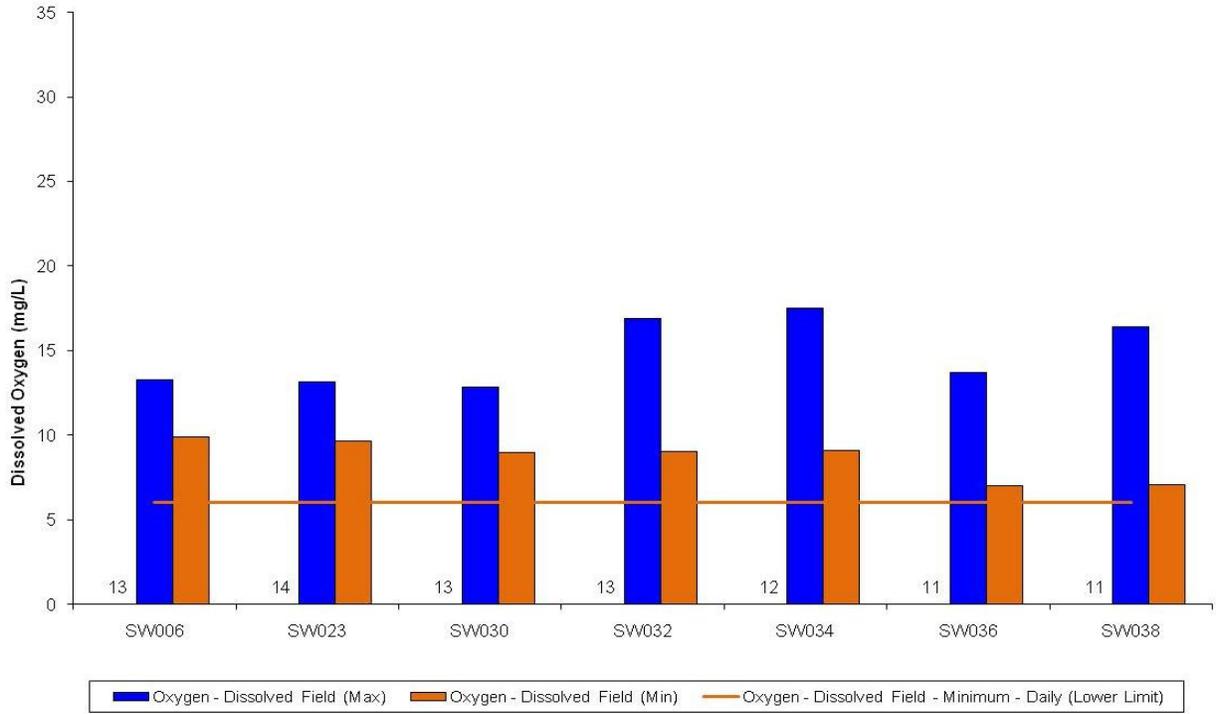


Figure 6.60 Class A Marine Water Dissolved Oxygen Results Compared with Water Quality Standards: 2010

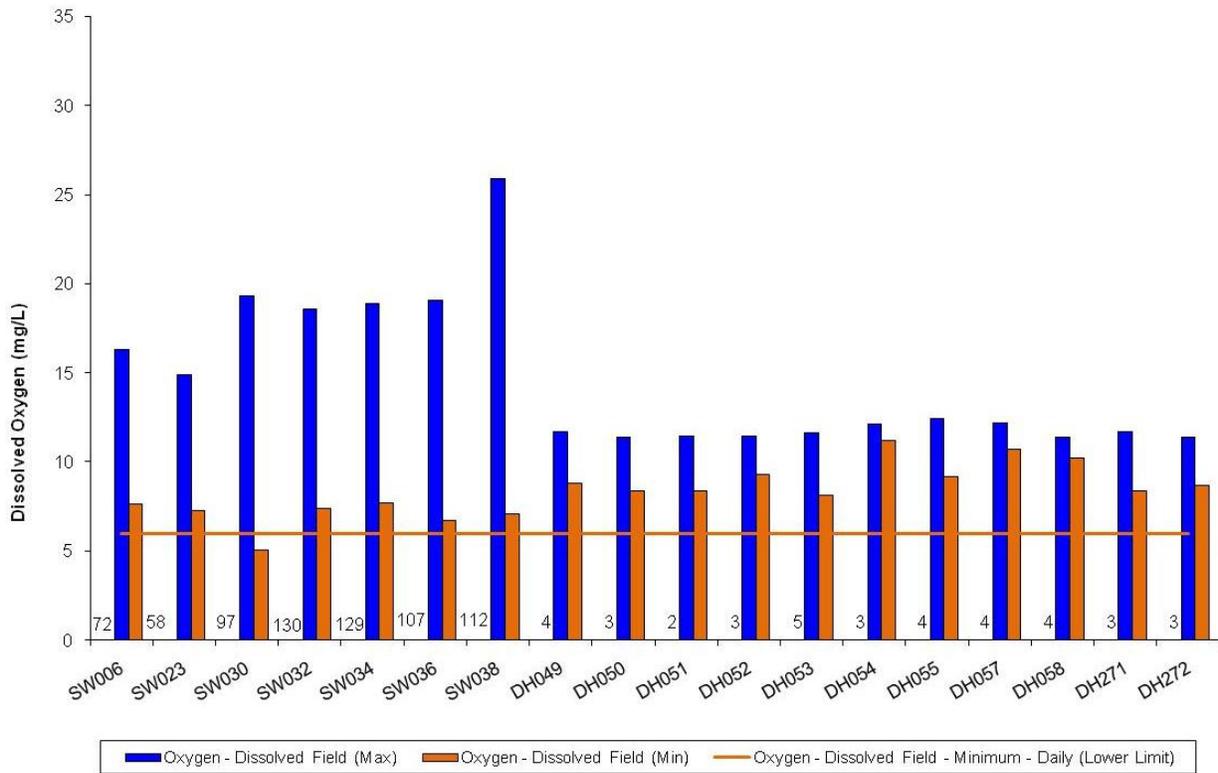


Figure 6.61 Class A Marine Water Dissolved Oxygen Results Compared with Water Quality Standards: Period of Record through 2009

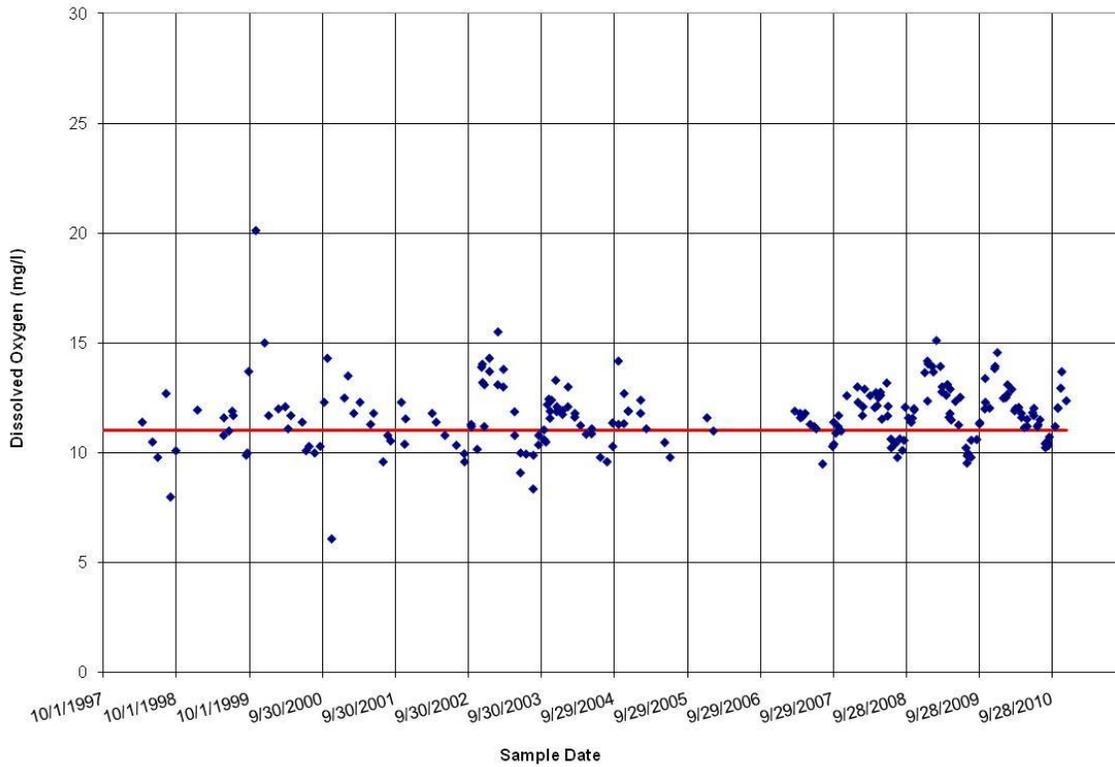


Figure 6.62 Class AA Fresh Water Dissolved Oxygen Results, Site SW018/SW118

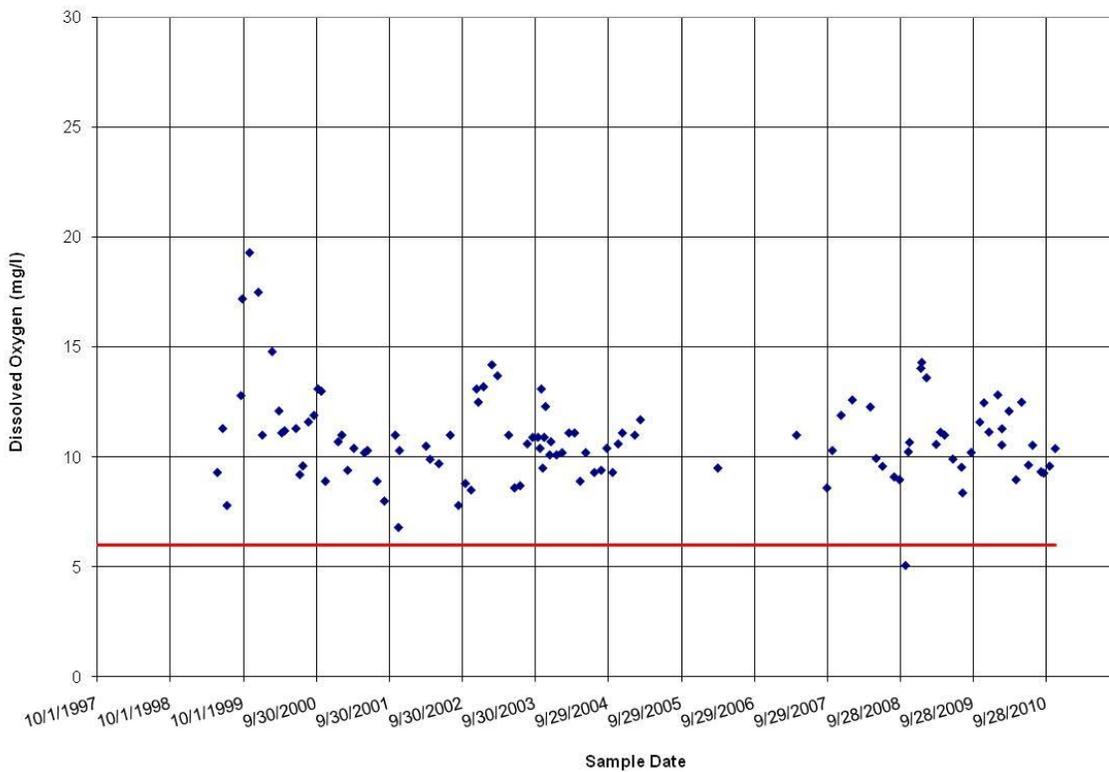


Figure 6.63 Class A Marine Water Dissolved Oxygen Results, Site SW030

6.6.3. Relationship between Dissolved Oxygen and Temperature

Water temperature influences the concentration of dissolved oxygen in a water body. In general, cold water can hold more oxygen than warm water. Adequate concentrations of dissolved oxygen are necessary for the health of fish and other aquatic organisms and to prevent offensive odors caused by anaerobic bacteria. Low dissolved oxygen levels can impact organisms' growth rates, swimming ability, susceptibility to diseases, and the ability to survive other environmental stressors and pollutants.

As summarized in Table 6.5, the relation between temperature and dissolved oxygen varies from site to site and there is generally a poor relationship between the two water chemistry variables. The best relationship, as defined by the highest coefficient of determination (r^2) and slope of the best-fit line close to 1, is for Site DH044 (inside Lummi Seasponds Aquaculture Dike).

Table 6.5 Relation Between Dissolved Oxygen and Temperature

Sample Site Number	Number of Sample Pairs	Slope	Intercept	R-Square
Fresh Water				
SW003	188	-0.90	19.08	0.15
SW007	178	-1.20	24.00	0.36
SW009	163	-1.40	24.40	0.30
SW010	182	-0.24	14.07	0.04
SW011	168	-0.47	15.27	0.08
SW012	328	-0.99	21.07	0.29
SW013	203	-0.36	13.92	0.05
SW014	133	0.38	9.85	0.23
SW015	168	-1.10	18.88	0.46
SW016	138	0.20	11.08	0.01
SW017	74	0.02	11.36	0.00
SW018	80	0.22	10.27	0.03
SW025	16	0.43	3.00	0.25
SW026	97	-0.50	18.13	0.04
SW027	132	-0.98	21.68	0.28
SW028	151	-0.73	23.25	0.15
SW029	97	-1.01	19.04	0.43
SW032	153	-0.26	15.26	0.01
SW034	165	-0.25	15.04	0.01
SW036	119	-0.64	19.44	0.06
SW038	122	-0.53	17.93	0.06
SW058	63	-0.18	12.05	0.05
SW072	74	-0.26	14.11	0.01
SW118	438	-2.09	33.80	0.48
Marine Water				
DH038	42	-0.15	11.57	0.01
DH039	30	-0.61	16.31	0.07
DH040	33	-0.10	11.95	0.00
DH041	29	0.61	5.29	0.23
DH042	23	0.04	11.51	0.00
DH043	23	-0.06	10.73	0.00
DH044	43	-3.68	46.95	0.74
DH045	58	-0.78	21.91	0.18
DH048	5	-0.02	6.94	0.01
DH285	31	0.40	7.42	0.03
DH286	25	0.13	9.52	0.00
DH287	33	-0.22	11.95	0.01
DH288	33	-0.44	14.17	0.05
SW001	87	0.15	11.78	0.01
SW002	138	0.17	10.40	0.02
SW006	117	-0.60	19.37	0.05
SW008	178	-1.20	24.00	0.36
SW019	77	-0.16	13.92	0.00
SW022	79	-0.33	15.58	0.04
SW023	96	-1.10	23.98	0.15
SW030	113	-1.09	23.96	0.18
SW031	95	-0.54	13.74	0.11
SW033	75	-0.61	14.52	0.05
SW035	67	0.16	7.36	0.01
SW037	72	-0.90	19.69	0.15
SW039	123	0.41	7.67	0.09
SW051	168	-1.48	27.27	0.20
SW052	114	-1.85	31.50	0.31
SW053	139	-1.44	25.65	0.22
SW055	79	-0.47	16.70	0.03
SW056	103	0.58	7.95	0.11
SW059	138	-0.83	17.18	0.15

6.7. pH Results

The water quality standards for pH (hydrogen ion concentration) set a range of acceptable values. If the maximum or minimum measured pH is not within the specified range, the sample results indicate that the characteristic uses of the water body are not supported.

6.7.1. Class AA Waters

The Class AA fresh water quality standard for pH is not less than 6.5 and not more than 8.5. As shown in Figure 6.64, the water quality data collected during 2010 indicate that the pH standard was achieved at 9 of the 16 sample sites. Although Site SW004 is shown in Figure 6.64 to have met the pH standard during 2010, this result is from only two samples. As described above, Site SW004 is only sampled during flood conditions in the Nooksack River. As shown in Figure 6.65, the pH standard was always achieved at 3 of the 16 sample sites (SW011, SW012, and SW004), over the period of record. The highest pH (most alkaline) levels were measured at the Nooksack River site (SW018/SW118) and the lowest pH (most acidic) levels were measured in a perennial stream (SW029) that drains an undeveloped portion of the Reservation.

The Class AA marine water quality standard for pH is not less than 7.0 and not more than 8.5. As shown in Figure 6.66, the water quality data collected during 2010 indicate that this standard was achieved at 18 of the 24 sample sites. As shown in Figure 6.67, 11 of the 24 sample sites met the pH standard over the period of record. The highest pH value was measured at the sample site along the Lummi River at the Hillaire Road Bridge (SW008) and the lowest pH value was measured in Smuggler's Slough in the Nooksack River/Lummi River floodplain (SW059).

As shown in Figure 6.68, the pH sample results for the representative Class AA fresh water site that contributes to a Class AA marine water site (SW009) have generally been more than 6.5 and less than 8.5 units. However, when there were multiple measurements during a particular day, the results were averaged in the data shown in Figure 6.68.

As shown in Figure 6.69, the pH sample results for the representative Class AA marine water site (SW002) have always been above the 6.5 pH threshold but have exceeded the 8.5 pH units threshold on two occasions over the period of record. Figure 6.68 and Figure 6.69 also show the gap in the pH data record that resulted from a combination of equipment malfunctions and staff changes.

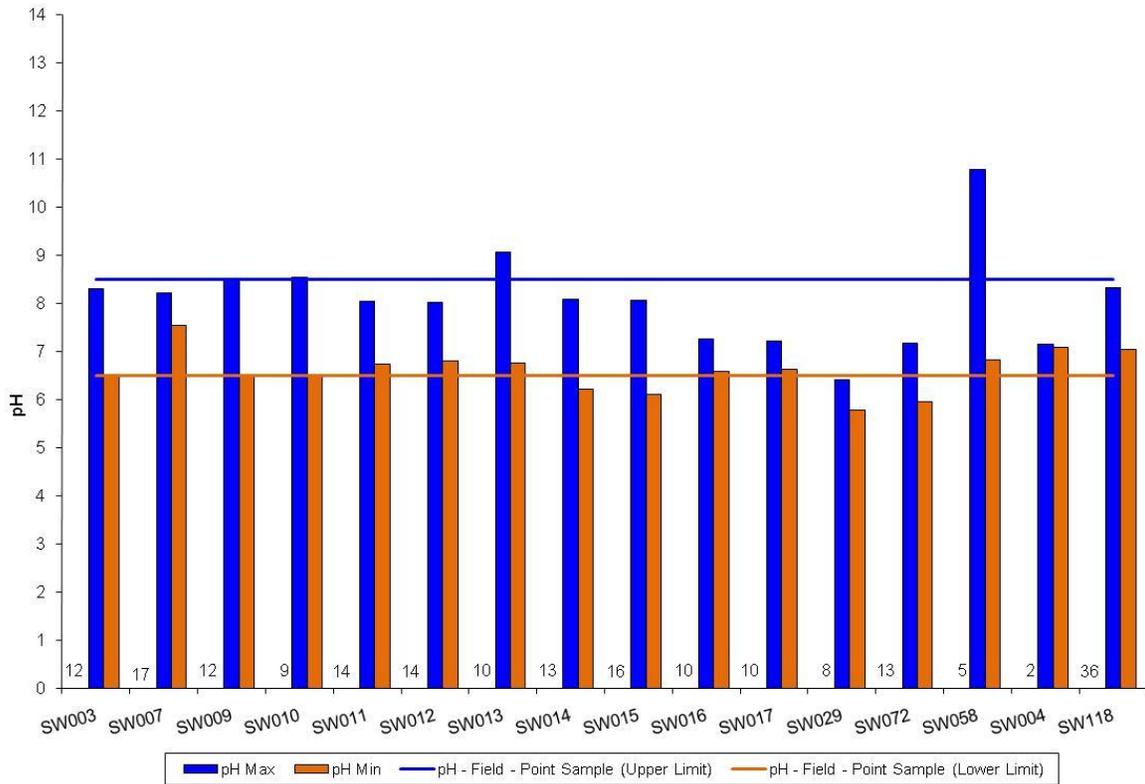


Figure 6.64 Class AA Fresh Water pH Results Compared with Water Quality Standards: 2010

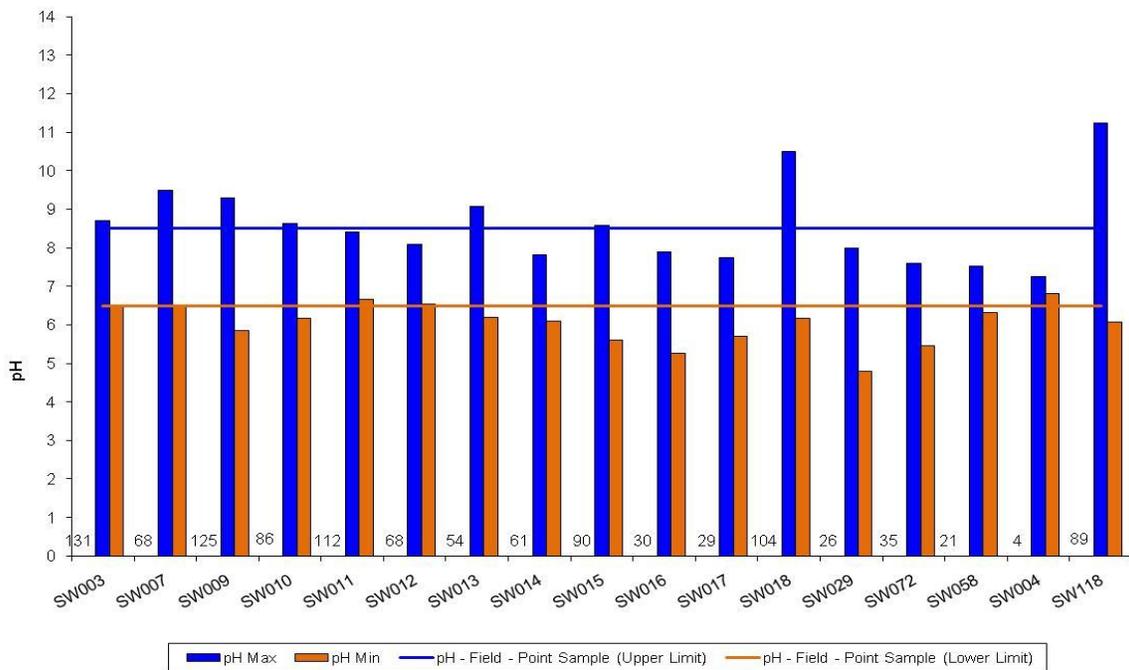


Figure 6.65 Class AA Fresh Water pH Results Compared with Water Quality Standards: Period of Record through 2009

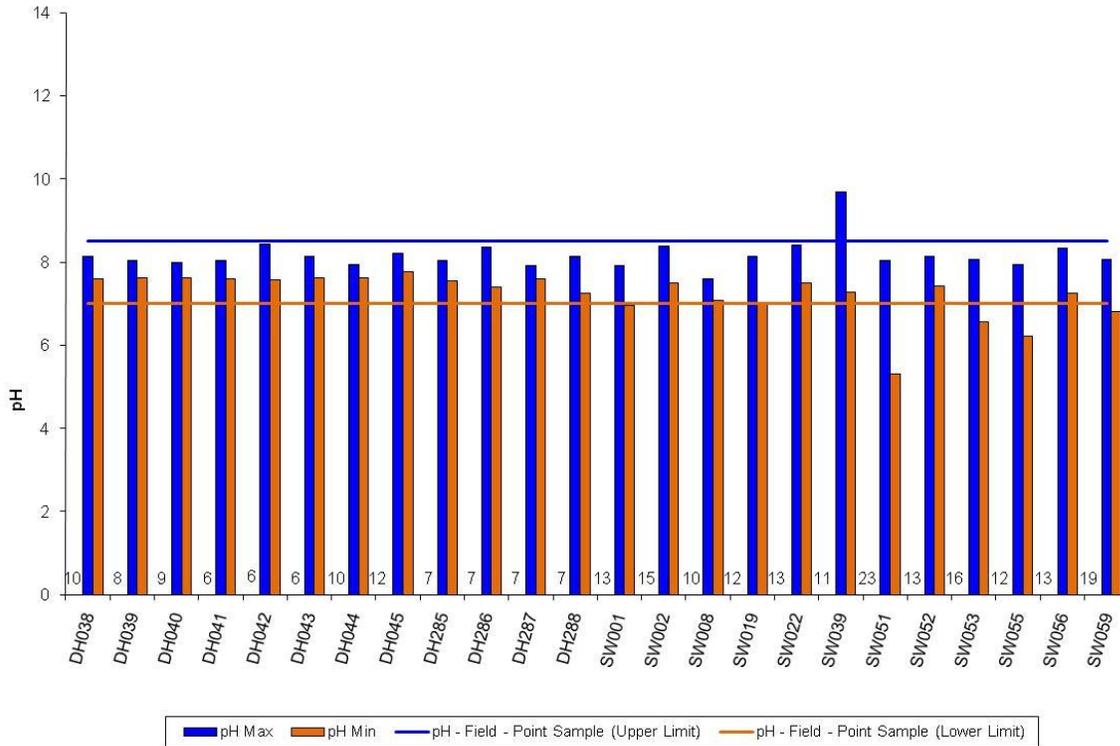


Figure 6.66 Class AA Marine Water pH Results Compared with Water Quality Standards: 2010

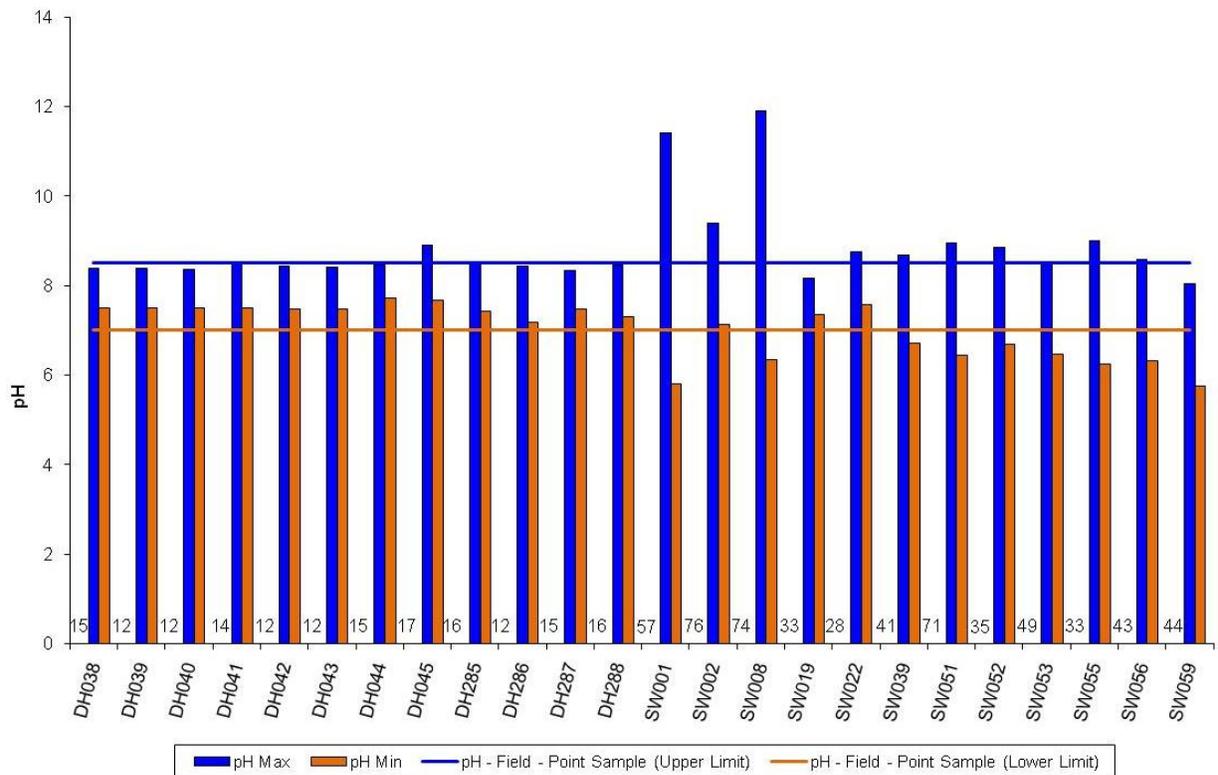


Figure 6.67 Class AA Marine Water pH Results Compared with Water Quality Standards: Period of Record through 2009

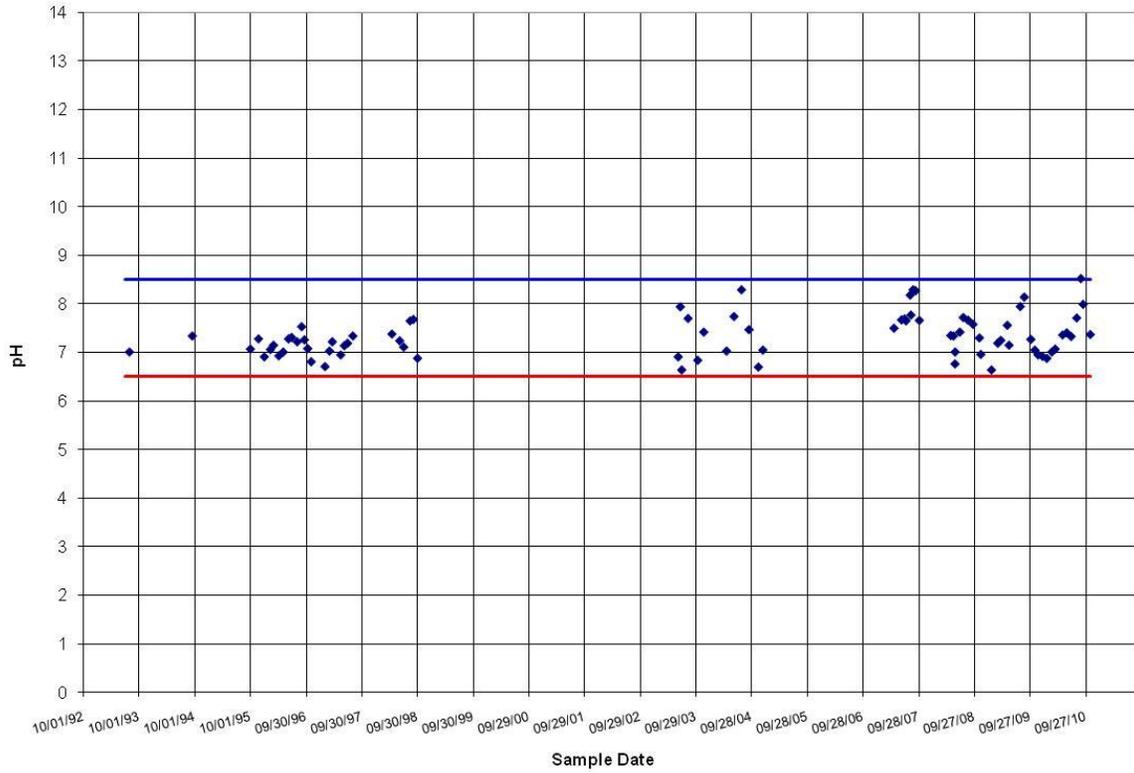


Figure 6.68 Class AA Fresh Water pH Results, Site SW009

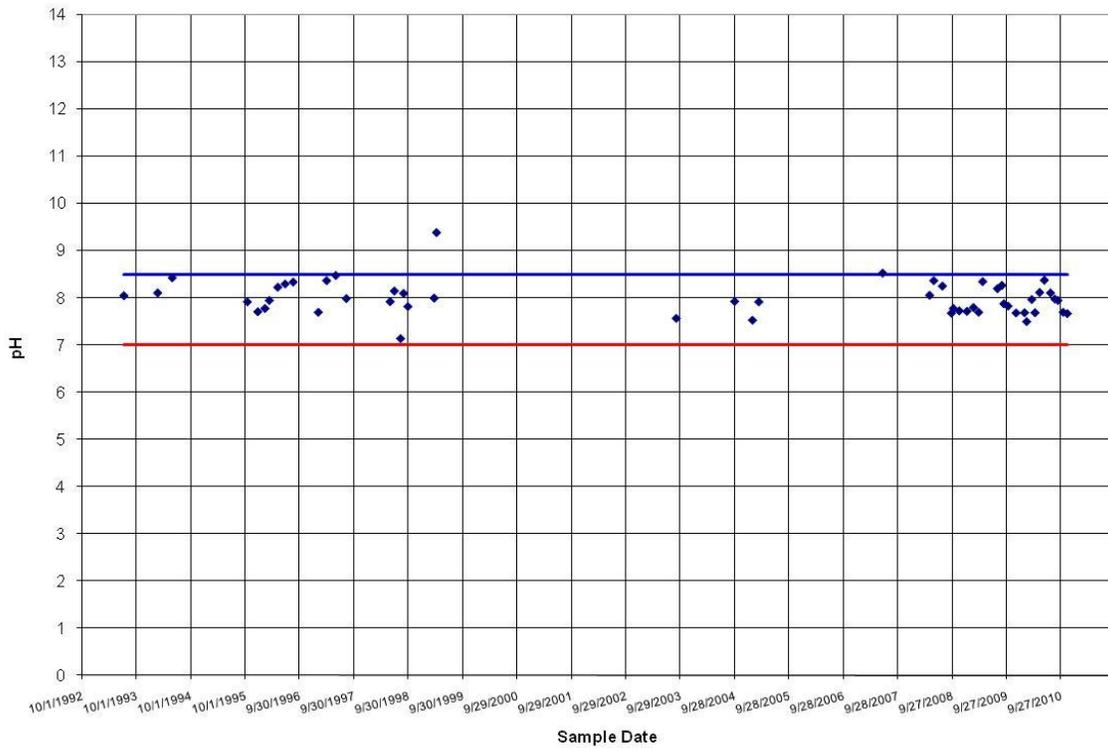


Figure 6.69 Class AA Marine Water pH Results, Site SW002

6.7.2. Class A Waters

The Class A fresh water quality standard for pH is not less than 6.5 and not more than 8.5. As shown in Figure 6.70, the water quality data collected during 2010 indicate that the standard was achieved at 5 of the 8 sample sites. Although sample sites SW025, SW035, and SW037 are shown in Figure 6.70 to have met the pH standard during 2010, these results reflect only two or three samples at each site. As shown in Figure 6.71, the pH standard was achieved at Site SW024 and Site SW037 for the period of record. Although Site SW004 has met the pH standard during the period of record, this result is from only two samples. Site SW037 is along a relatively dense residential area along the Portage Bay shoreline. The lowest pH values were measured at Site SW033, which drains a wooded area along the Lummi Peninsula.

The Class A marine water quality standard for pH is not less than 7.0 and not more than 8.5. As shown in Figure 6.72, the water quality data collected during 2010 indicate that this standard was achieved at 3 of the 7 Class A marine water quality sample sites. As shown in Figure 6.73, none of the sample sites met the standard consistently over the period of record. At 3 of the 7 sites, the pH was above the maximum pH threshold and below the minimum pH threshold at least once. The highest pH value was measured during 2010 at the sample site located in Portage Bay along Lummi Shore Road (SW032) and the lowest pH value was measured in another part of Portage Bay just offshore of Site SW024 (SW023).

As shown in Figure 6.74, the pH sample results for the representative Class AA fresh water site that contributes to a Class A marine water site (SW018/SW118 on the Nooksack River along the Reservation boundary) have generally met the standard over the period of record but there have been several measurements both above and below the standard. As shown in Figure 6.75, the pH sample results for the representative Class A marine water site (SW030 in Bellingham Bay) have generally met the standard but there are several measurements below the 7.0 pH units threshold over the period of record. Similar to the Class AA pH results, Figure 6.74 and Figure 6.75 show the gap in the pH data record that resulted from a combination of equipment malfunctions and staff changes.

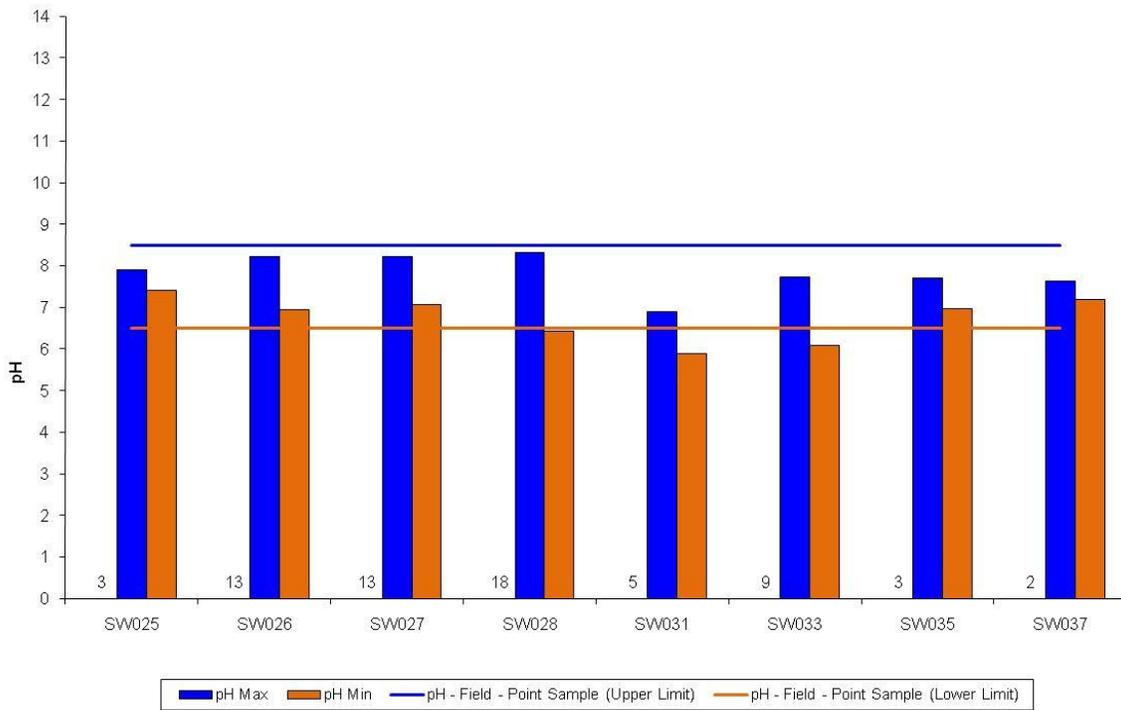


Figure 6.70 Class A Fresh Water pH Results Compared with Water Quality Standards: 2010

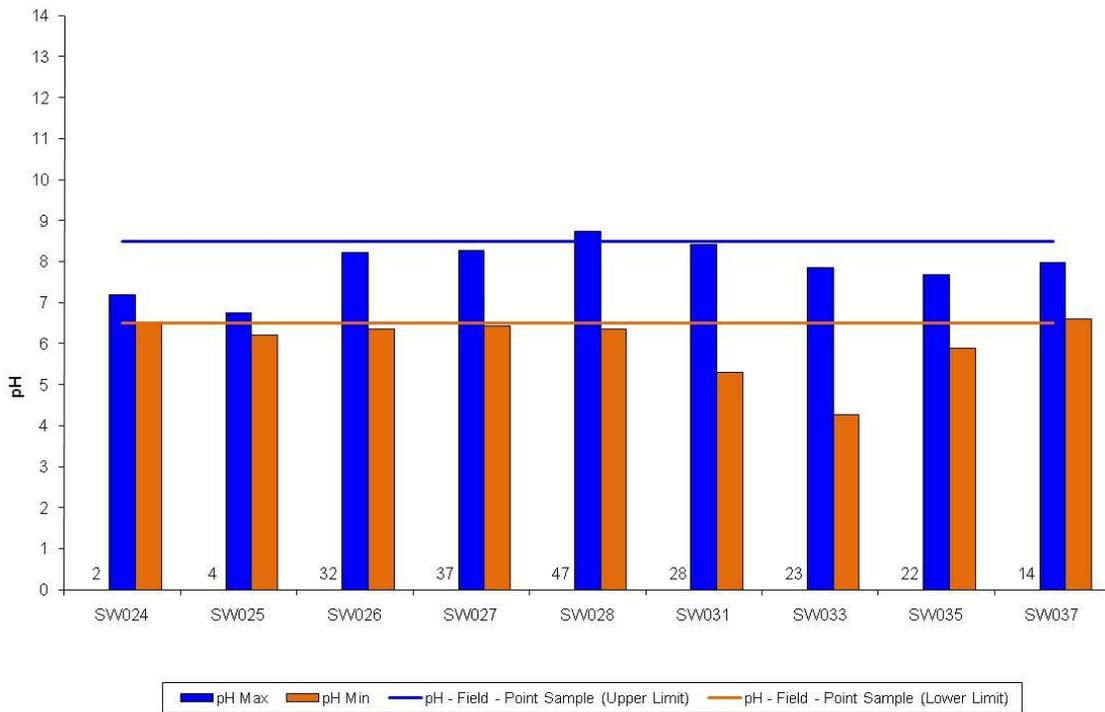


Figure 6.71 Class A Fresh Water pH Results Compared with Water Quality Standards: Period of Record through 2009

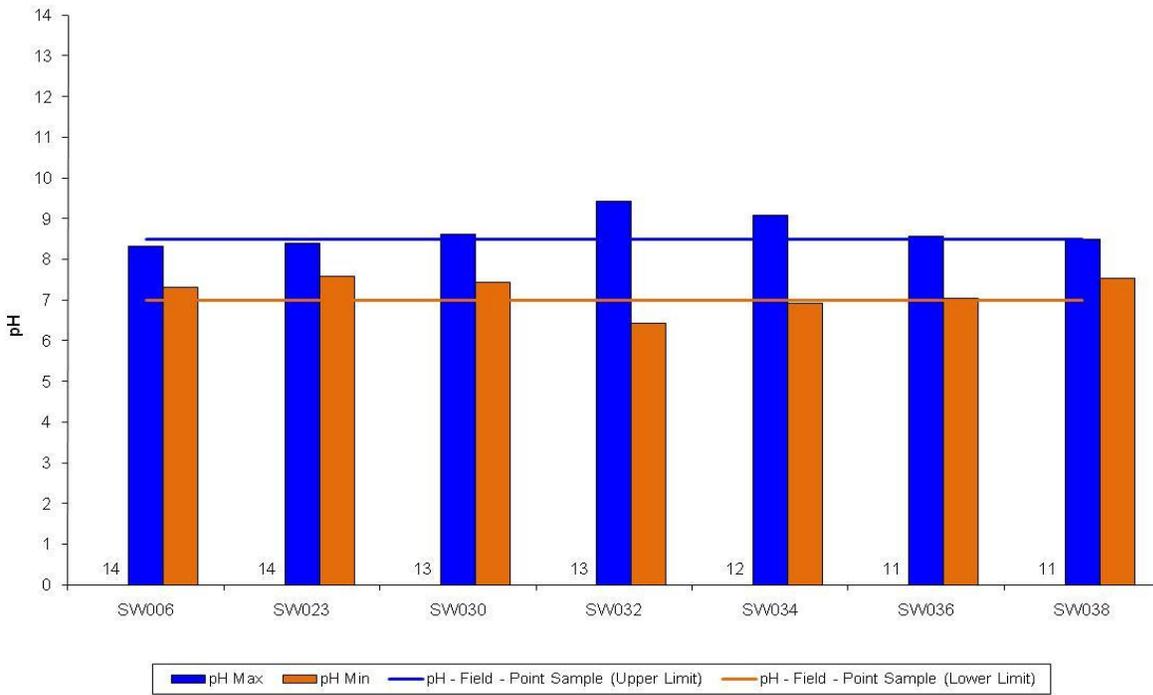


Figure 6.72 Class A Marine Water pH Results Compared with Water Quality Standards: 2010

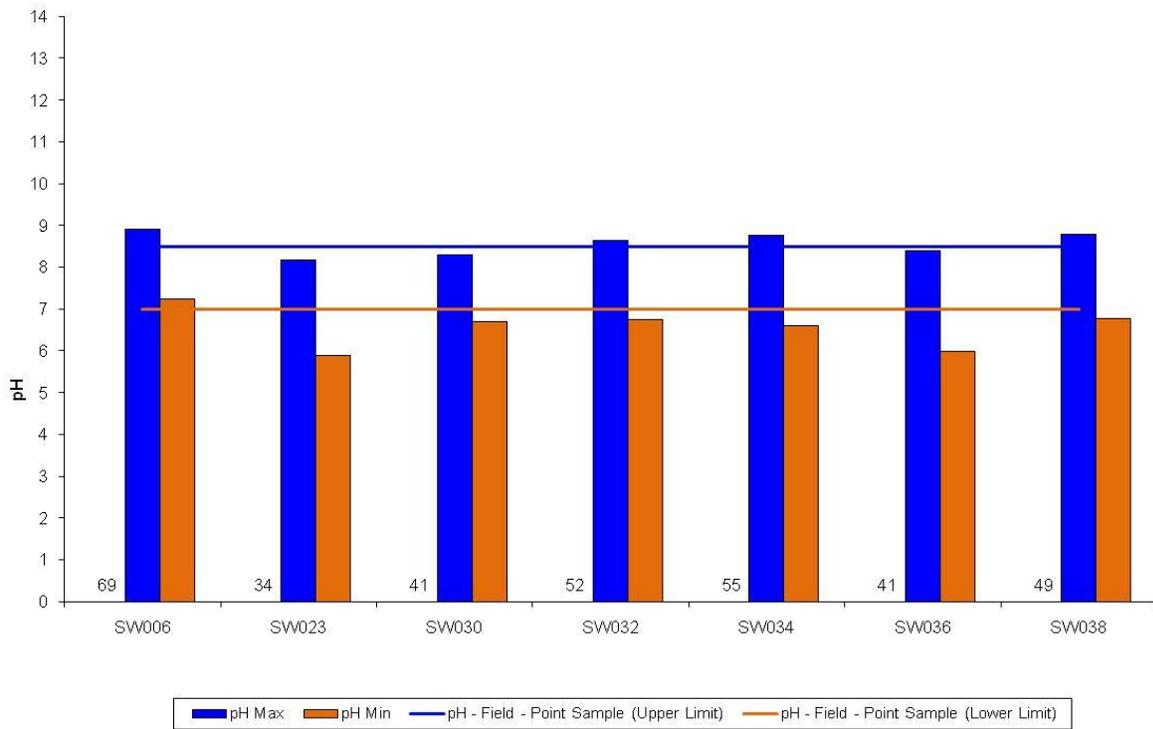


Figure 6.73 Class A Marine Water pH Results Compared with Water Quality Standards: Period of Record through 2009

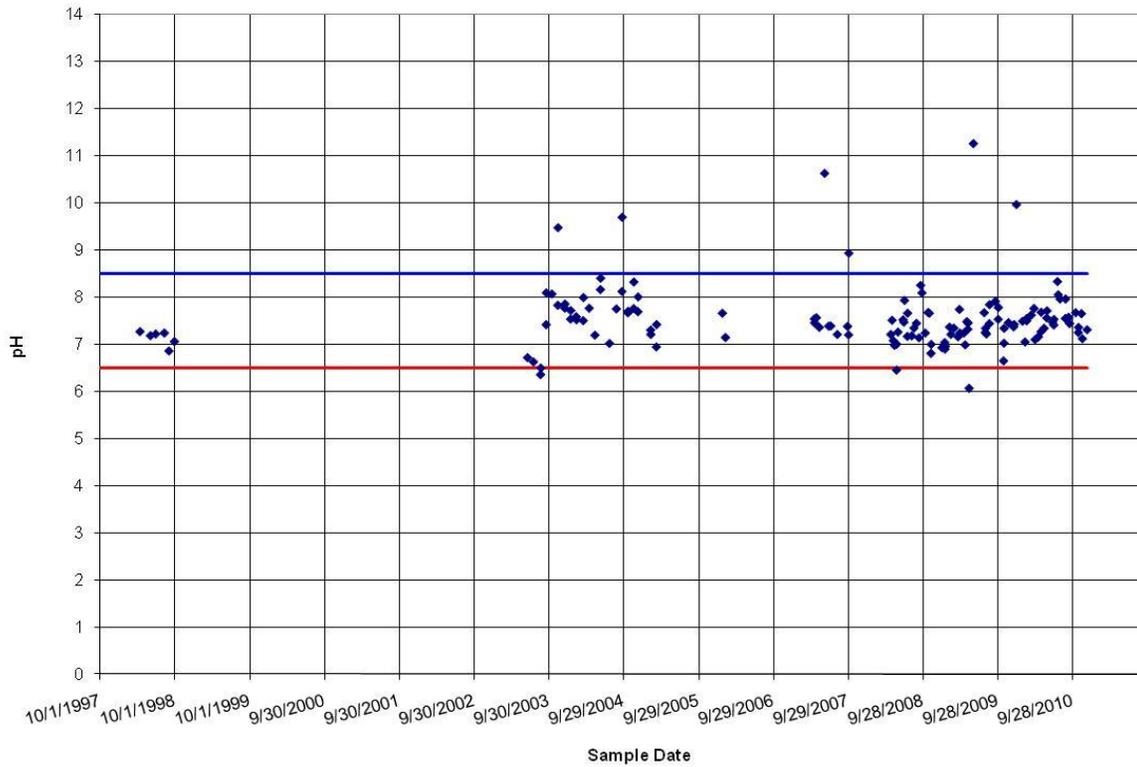


Figure 6.74 Class AA Fresh Water pH Results, Site SW018/SW118

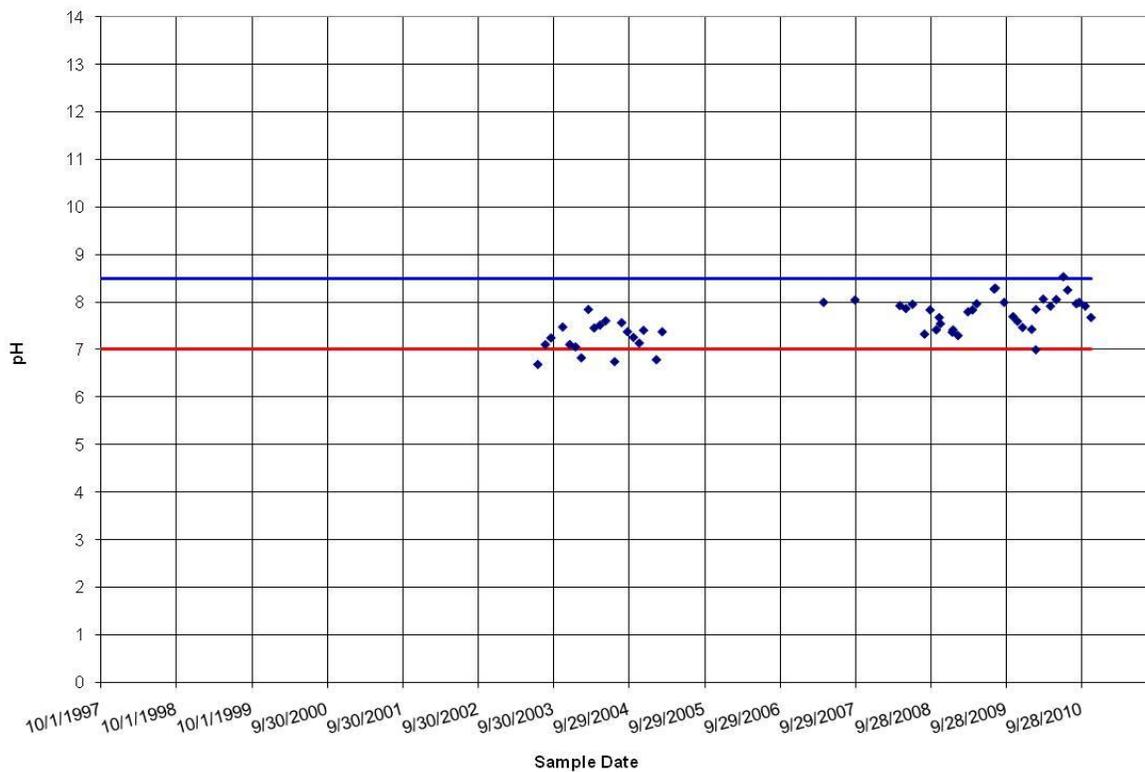


Figure 6.75 Class A Marine Water pH Results, Site SW030

6.8. Turbidity Results

The turbidity water quality standard is expressed as relative to background turbidity levels and is the same for Class AA and Class A waters. To comply with the Lummi Nation water quality standards, the turbidity level shall not exceed 5 nephelometric turbidity units (NTUs) over background turbidity when the background turbidity is less than or equal to 50 NTUs or the turbidity shall not exceed more than 10 percent of the background turbidity when the background turbidity is greater than 50 NTUs. For regulatory purposes (e.g., a construction site) the background turbidity is measured upstream from where storm water from a site discharges to receiving waters and compliance is determined by comparison of this upstream value with the turbidity measurement collected downstream from the point or points that the storm water from the site discharges to the receiving waters.

6.8.1. Nephelometer Results

Turbidity is a measure of the degree to which light is scattered by suspended particulate material and soluble colored compounds in the water. It provides an estimate of the muddiness or cloudiness of the water due to clay, silt, finely divided organic and inorganic matter, plankton, and other microscopic organisms. Turbidity is commonly measured with a nephelometer and is reported in nephelometric turbidity units (NTUs). Turbidity is also commonly measured with a Secchi disc. Equipment and staff constraints have previously limited the collection of turbidity data at the surface water quality sample stations. These obstacles were overcome in April 2008 and a nephelometer is now used regularly to determine both background levels and for regulatory compliance with the water quality standards. On the marine boat accessible run and Lummi Bay DOH support run (Table 4.1) a Secchi disc is used to measure water clarity. Secchi depth measurements have not been collected consistently during the period of record, but since 2009 Secchi depth has been measured at all sample sites during monthly marine boat runs. It is recognized that turbidity levels are highly dependent on stream flow and that since stream flow is not commonly measured at most of the sample stations, the comparability of the turbidity data between sites and sampling events is limited. However, the increased measurement of turbidity as part of the ambient water quality program will help establish the background turbidity level for compliance with the water quality standards.

As shown in Figure 6.76, sample Site SW014 was the only Class AA fresh water sample sites was always below 50 NTUs during 2008 through 2010. The average turbidity was below 50 NTUs at 12 of the 15 sites. During 2008 through 2010, the highest Class AA fresh water turbidity measured was 476 NTUs at Site SW007 (a Nooksack River tributary channel) and the lowest turbidity measured was 2 NTUs at Site SW012 (Schell Creek). As shown in Figure 6.77, during 2008 through 2010, five of the eight Class A sample sites were always below 50 NTUs. All the sample sites have a low number of data values due to low flow or no flow during the summer months.

Turbidity is measured using the nephelometer at marine sample sites in the Lummi River Delta and along the Lummi Peninsula/Portage Bay shoreline. As shown in Figure 6.78, the turbidity at all Class AA marine sample sites were greater than 50 NTUs at least once during 2008 through 2010, except at Site SW052 (inside Seaponds Aquaculture Dike). However, the average turbidity was below 50 NTUs at all Class AA marine sample sites. Sample Site

SW008 (Lummi River at Hillaire Road) had the highest turbidity recorded of the Class AA Marine sample sites, at 187 NTUs. Site SW008 is downstream from Site SW009 on the Lummi River but is a Class AA marine water site (LWRD 2008a). The maximum turbidity at Site SW008 (187 NTUs) is lower than the maximum value at Site SW009, which at 450 NTUs was the second highest turbidity value of all 25 fresh water sites. As shown in Figure 6.79, all Class A marine sample sites had turbidity values exceeding 50 NTUs at least once during 2008 through 2010. Sample Site SW030 (Bellingham Bay) had the highest Class A marine water turbidity recorded, 821 NTUs, and an average turbidity greater than 50 NTUs. As shown in Figure 6.79, the turbidity at the sample sites decreased further along the Lummi Peninsula/Portage Bay shoreline moving away from the mouth of the Nooksack River toward Hermosa Beach. These trends suggest that the large quantity of highly turbid water flowing down the Nooksack River impacts turbidity measurements at the Portage Bay sample sites.

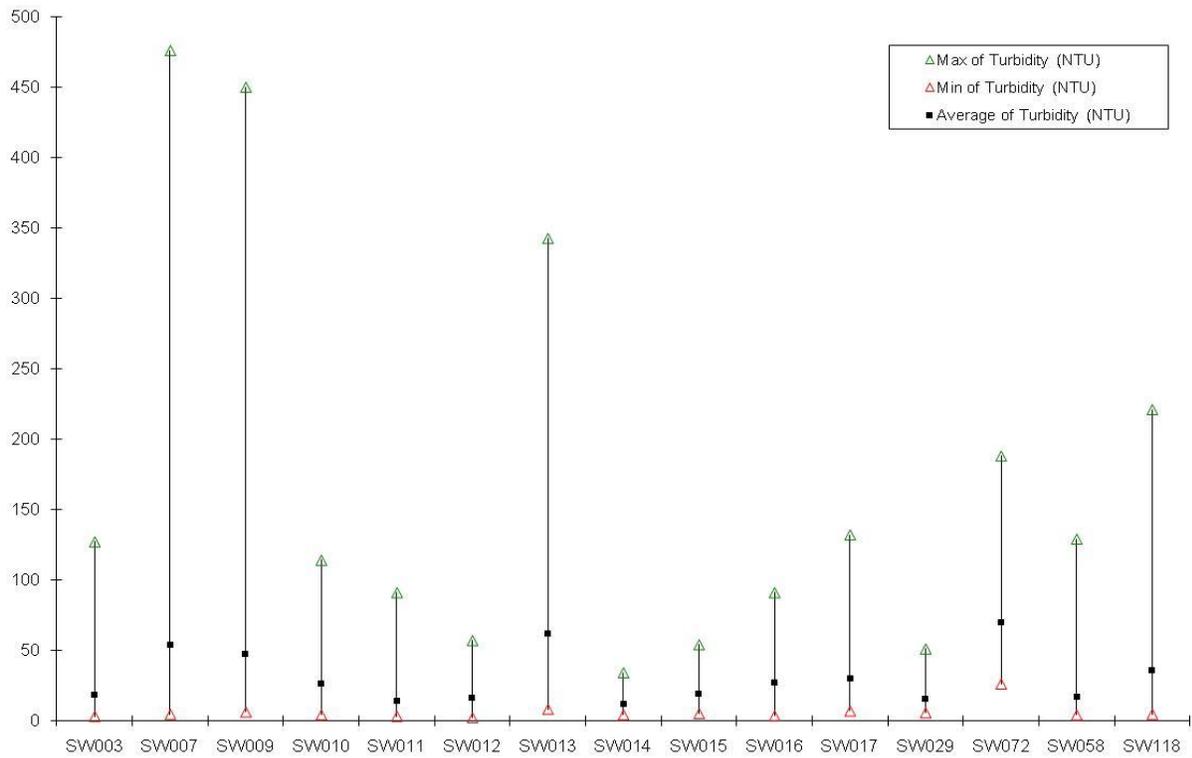


Figure 6.76 Class AA Fresh Water Turbidity Results (NTU): 2008 - 2010

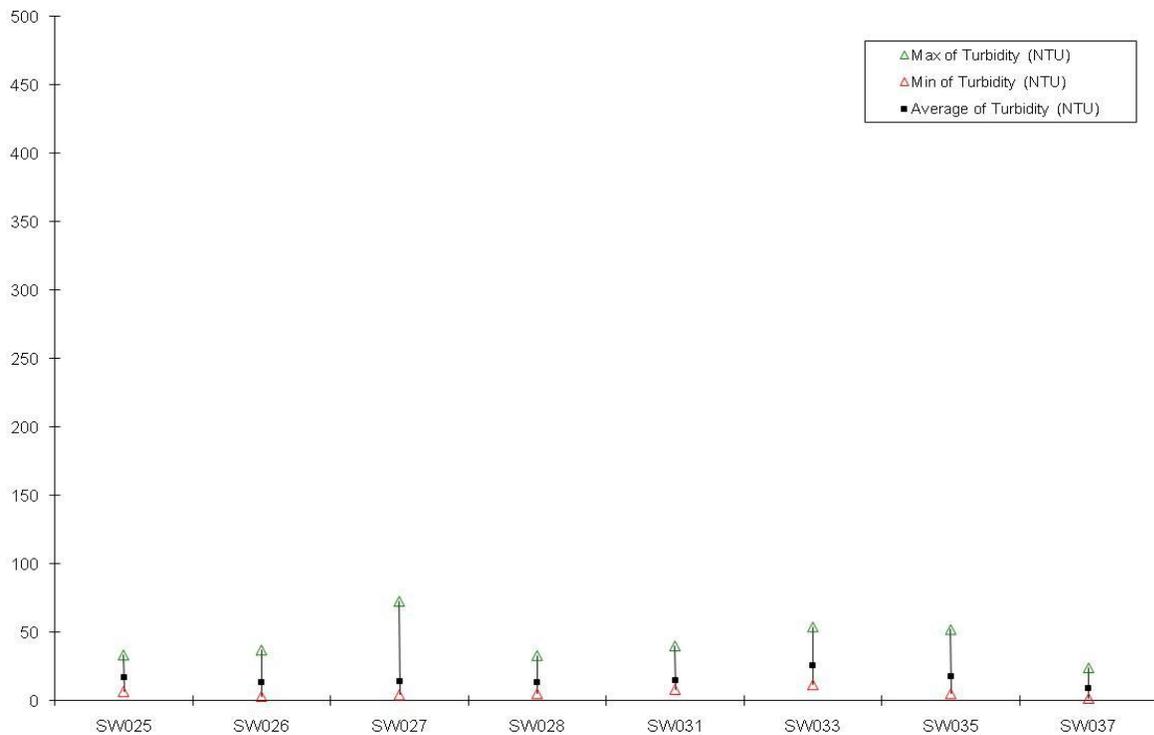


Figure 6.77 Class A Fresh Water Turbidity Results (NTU): 2008 - 2010

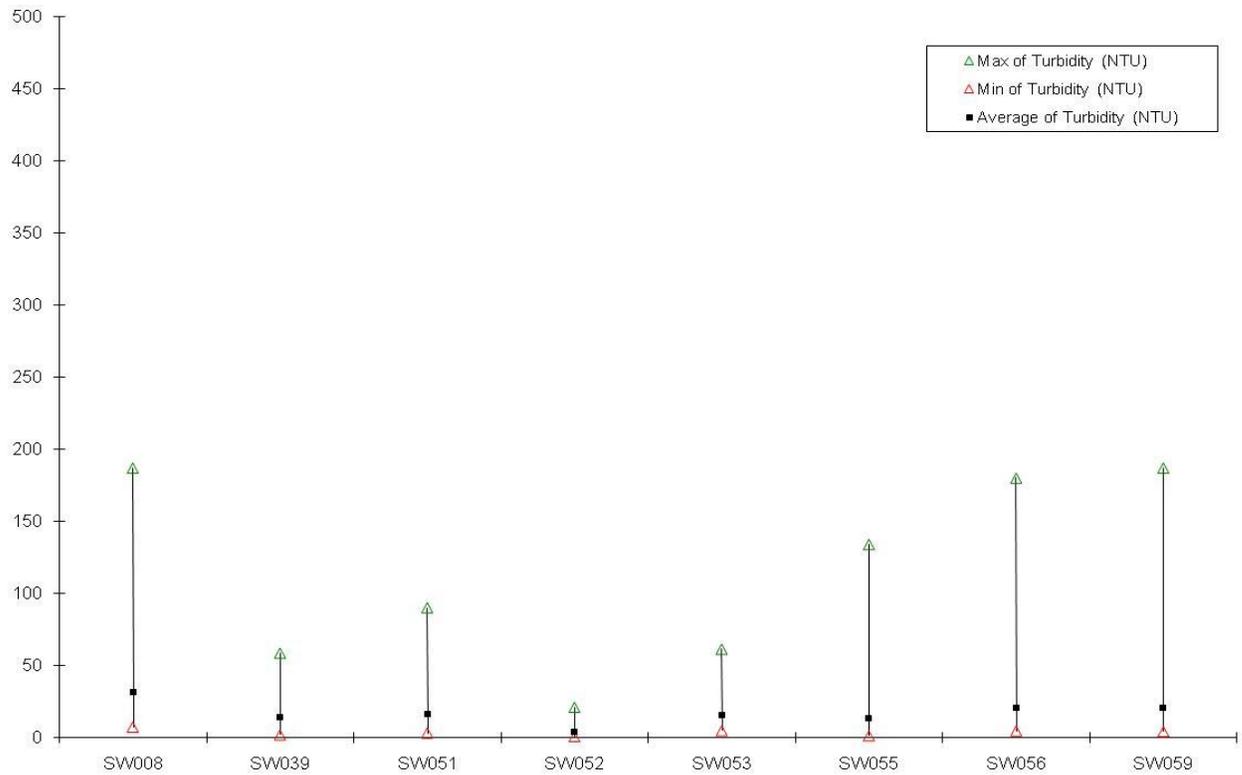


Figure 6.78 Class AA Marine Water Turbidity Results (NTU): 2008 - 2010

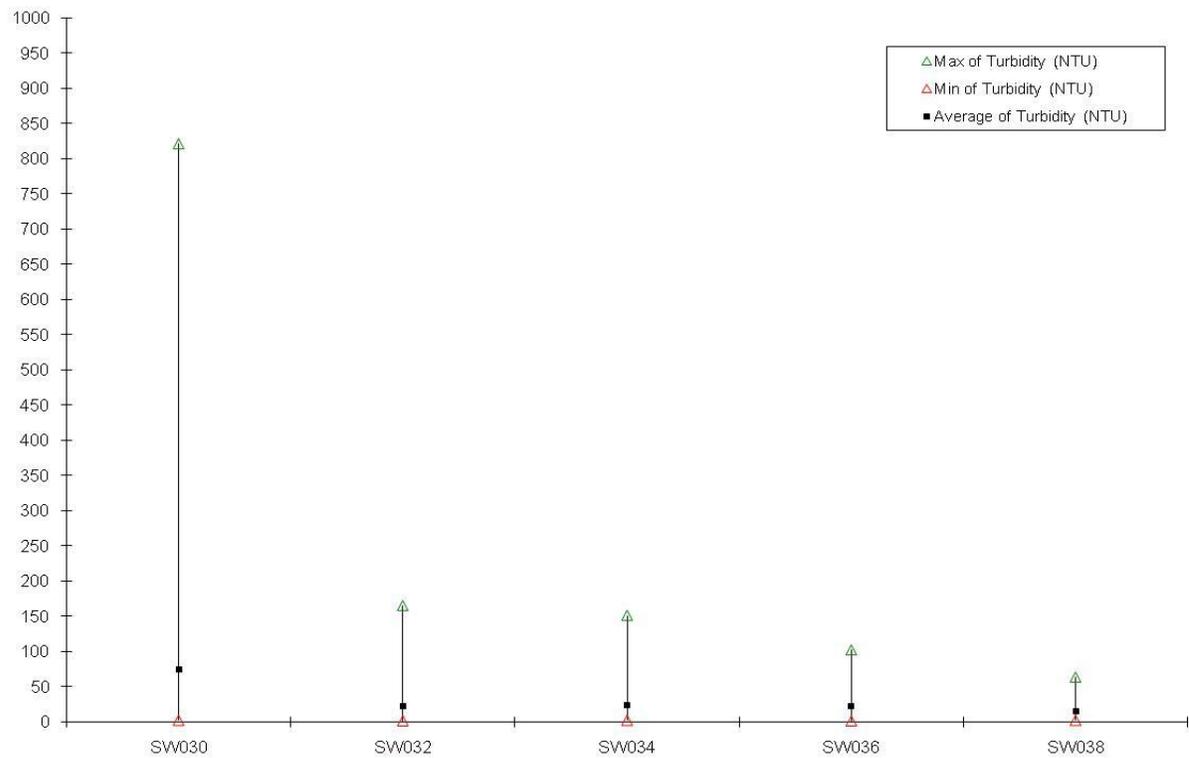


Figure 6.79 Class A Marine Water Turbidity Results (NTU): 2008 - 2010

6.8.2. Total Suspended Solid Results

Total suspended solids (TSS) are very closely associated with turbidity and are expressed in milligrams per liter (mg/l). Total suspended solids have been measured at five reference stations on a quarterly basis. The five reference stations and associated water quality classifications are the following:

- Site SW002 - Class AA Marine Water
- Site SW003 - Class AA Fresh Water
- Site SW006 - Class A Marine Water
- Site SW009 - Class AA Fresh Water
- Site SW015 - Class AA Fresh Water

During 2010, a TSS sample was taken only once at each of the five reference stations and twice at SW015, due to time and resource constraints. As all of the Class A fresh water sites on the Reservation are small intermittent streams, the limited availability of flow at these Class A fresh water sites makes monthly sampling for the nutrient suite (including TSS) impractical due to schedule and cost considerations.

All five reference stations were sampled for TSS once during 2010, except Site SW015 which was sampled twice. The TSS level at Site SW002 was 2.8 mg/l, Site SW003 was 20 mg/l, Site SW006 was 5.3 mg/l, and Site SW009 was 23 mg/l. In January 2010, Site SW015 had a TSS level of 22 mg/l and when sampled again in May 2010 had a TSS level of 7.8 mg/L. As shown in Figure 6.80 the quarterly TSS measurements at 3 of the 5 sample sites were below 50 mg/l during the period of record through 2010 with the lowest TSS levels measured at Site SW006 (Portage Bay). As shown in Figure 6.80 and Figure 6.81, the highest TSS levels were measured at Site SW009 (Lummi River at Slater Road) for the period of record through 2010. Two measurements at this station were collected on August 23, 2001 during a period when the Nooksack River was discharging to the Lummi River channel (which occurs when the flow in the Nooksack River is above approximately 9,600 cfs). A third high TSS measurement was collected November 7, 2008 following several days of significant rainfall. Although TSS measurements greater than 50 mg/l were also recorded at Site SW002, in general the TSS measurements are less than 50 mg/l. Figure 6.81 shows the TSS measurements over the period of record through 2010 at the three Class AA surface water sites in the Lummi Bay watershed. As shown in Figure 6.81, other than the two measurements collected at Site SW009 on August 23, 2001, described above, a single measurement in Lummi Bay, and one measurement in November 7, 2008, all of the TSS measurements were below 50 mg/l.

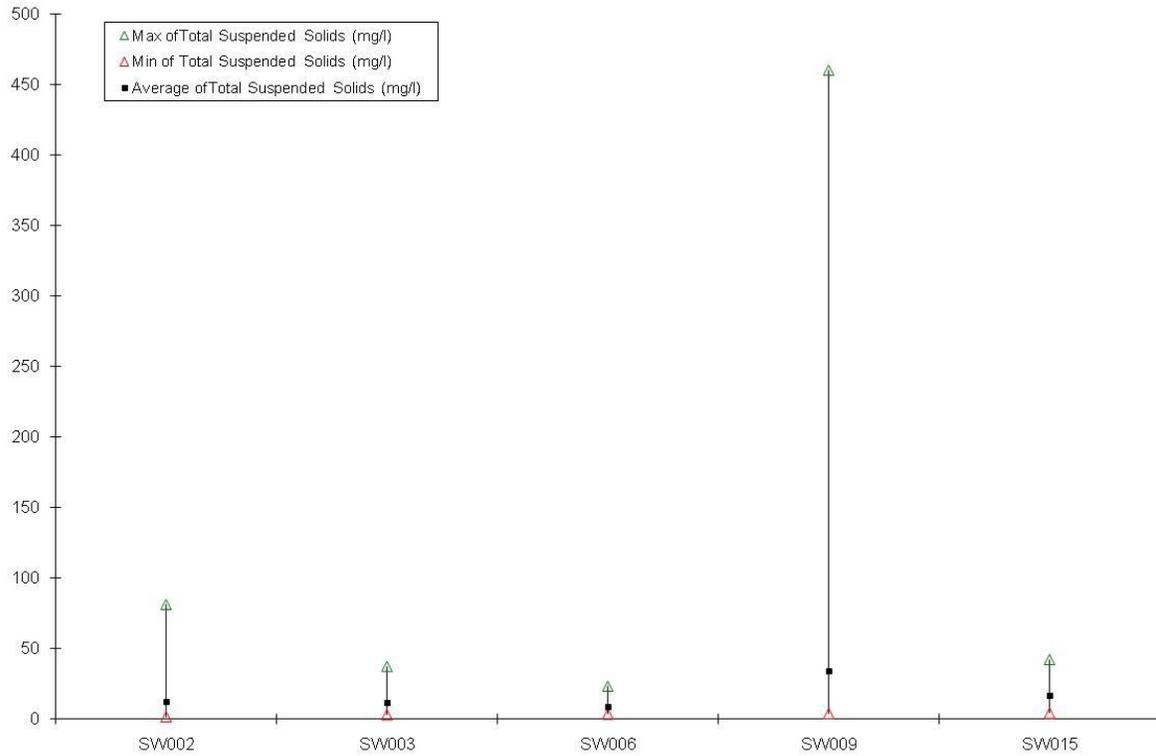


Figure 6.80 Total Suspended Solids Results: Period of Record through 2010

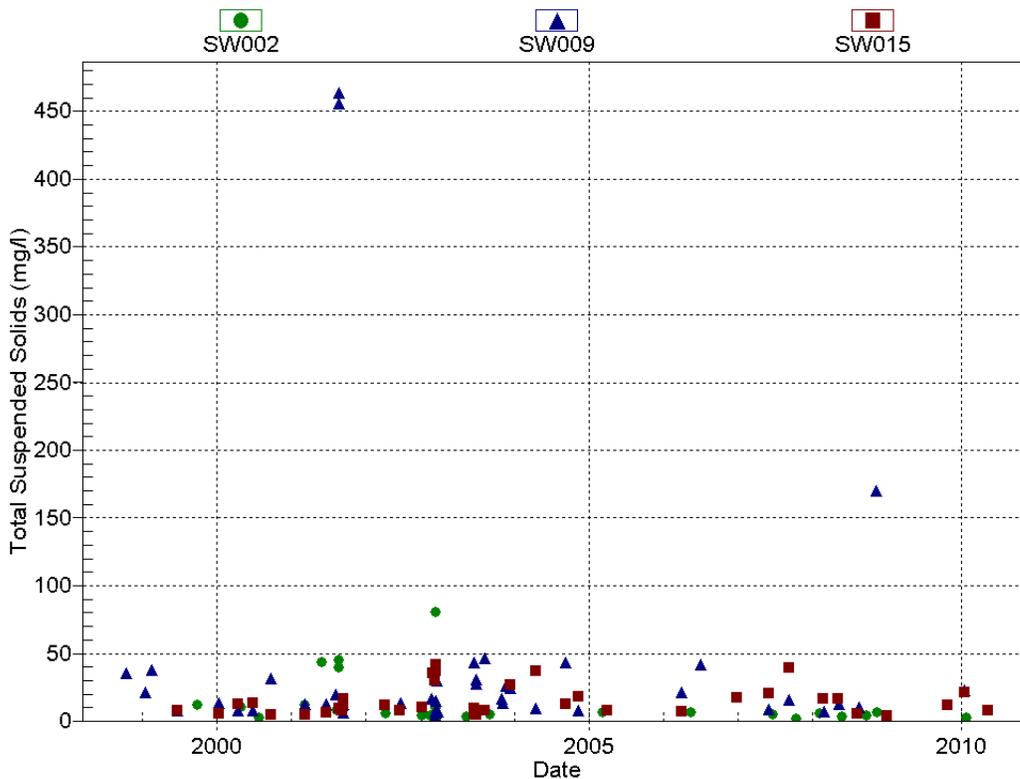


Figure 6.81 Total Suspended Solids Results at Class AA Surface Water Sites: Period of Record through 2010

6.9. Nutrients Results

A nutrient suite, including total phosphorus (milligrams per liter) and total nitrogen (milligrams per liter), is measured quarterly at the same five reference sites where TSS is measured. Similar to TSS due to time and resource constraints, each station was sampled once for the nutrient suite during 2010 except Site SW015, which was sampled twice. Phosphorus and nitrogen are essential nutrients for plant growth. However, elevated phosphorus and nitrogen levels can result in algae blooms, which can interfere with other aquatic life forms (Hem 1989) and can cause a number of environmental and health problems including:

- Aesthetic degradation – water with large algae blooms is murky, has bad odor, and is generally undesirable for water contact recreation such as swimming, wading, fishing, and boating.
- Aquatic habitat degradation – algae can result in low oxygen levels in the water when the algae decay, which can result in winter and summer fish kills.
- Toxin production – certain species of blue-green algae can produce toxins that can affect people and animals that swim and drink from water with severe algae blooms.
- Drinking water degradation – excessive algae in drinking water supplies can affect the taste and odor of drinking water and increase treatment costs.
- Disrupt fish harvests – excess algae can clog fishing nets.

6.9.1. Total Phosphorus Results

During 2010, only one total phosphorous level was collected at each of the five sample stations. The total phosphorous level for Site SW002 was 0.33 mg/l, Site SW003 was 0.09 mg/l, Site SW006 was 0.26 mg/l, and SW009 was 0.35 mg/l. In January 2010, Site SW015 had a total phosphorous level of 0.62 mg/l and in May 2010 had a level of 0.16 mg/l. As shown in Figure 6.82 and Figure 6.83, Site SW009 had the highest total phosphorus values measured over the period of record through 2010, and the two marine water sites (SW002 and SW006) had the lowest total phosphorus values over the period of record. The two other fresh water sample sites in the floodplain (SW003 and SW015) had similar ranges and average total phosphorus levels.

Phosphorus is highly immobile and needs to be attached to a surface for transportation. Soil is frequently a point of attachment for phosphorus, and when soils are exposed, they are susceptible to erosion and can easily be washed into streams and bays during storm events together with the adhered phosphorus. Large areas of land that have been cleared for agriculture and construction sites and are not configured with proper best management practices can contribute a significant amount of nutrient-containing sediments to nearby water bodies.

As shown in Figure 6.83, although there are a few instances with higher total phosphorus levels in the fresh water sites, particularly along the Lummi River at Slater Road (Site SW009), the total phosphorus measurements are generally below 1 mg/l. As reported in Dunne and Leopold (1978), in 1967 a committee of the American Water Works Association (AWWA) published the range of usual concentrations of phosphorus in discharges from

various land uses. The usual concentration of phosphorus in rural runoff from agricultural lands is 0.05 to 1.1 mg/l and the usual concentration of phosphorus for rural runoff from non-agricultural lands is 0.04 to 0.2 mg/l. There was insufficient data for the AWWA committee to make an estimate for the usual range of phosphorus concentration where farm animal waste was the source, but the committee estimated a range of 3.5 to 9 mg/l of phosphorus for domestic waste. The concentration of total phosphorus at the fresh water sites indicates that the sources of phosphorus are from agricultural land, which is prevalent in off-Reservation watersheds.

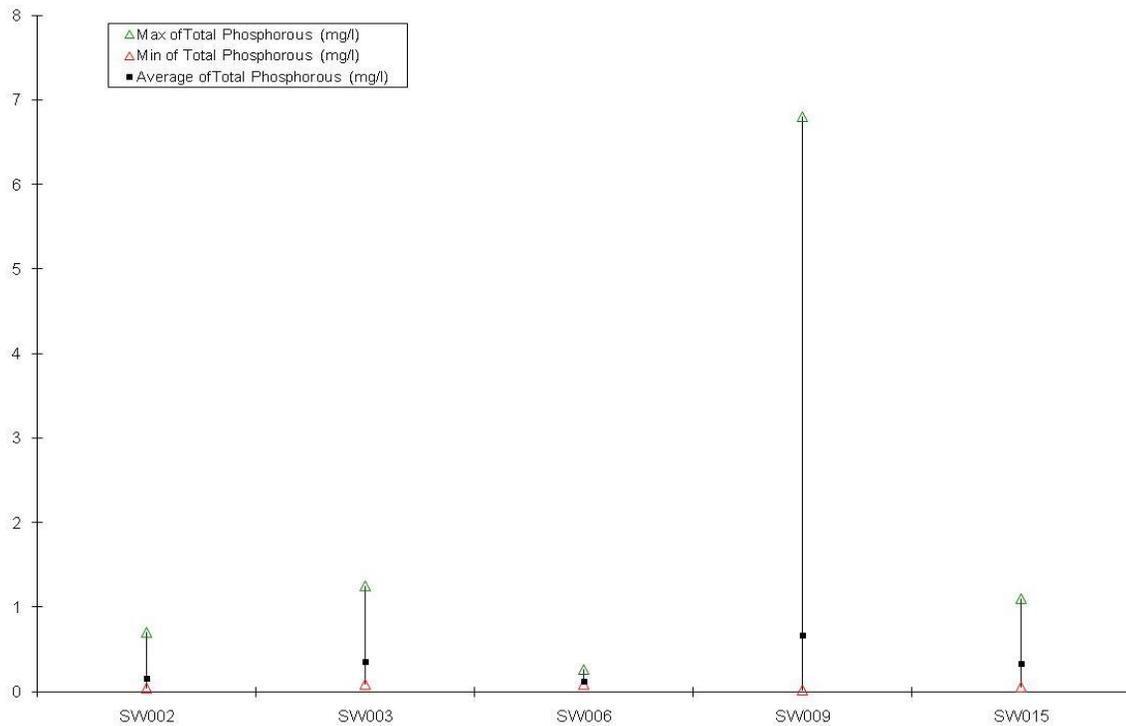


Figure 6.82 Total Phosphorus Results: Period of Record through 2010

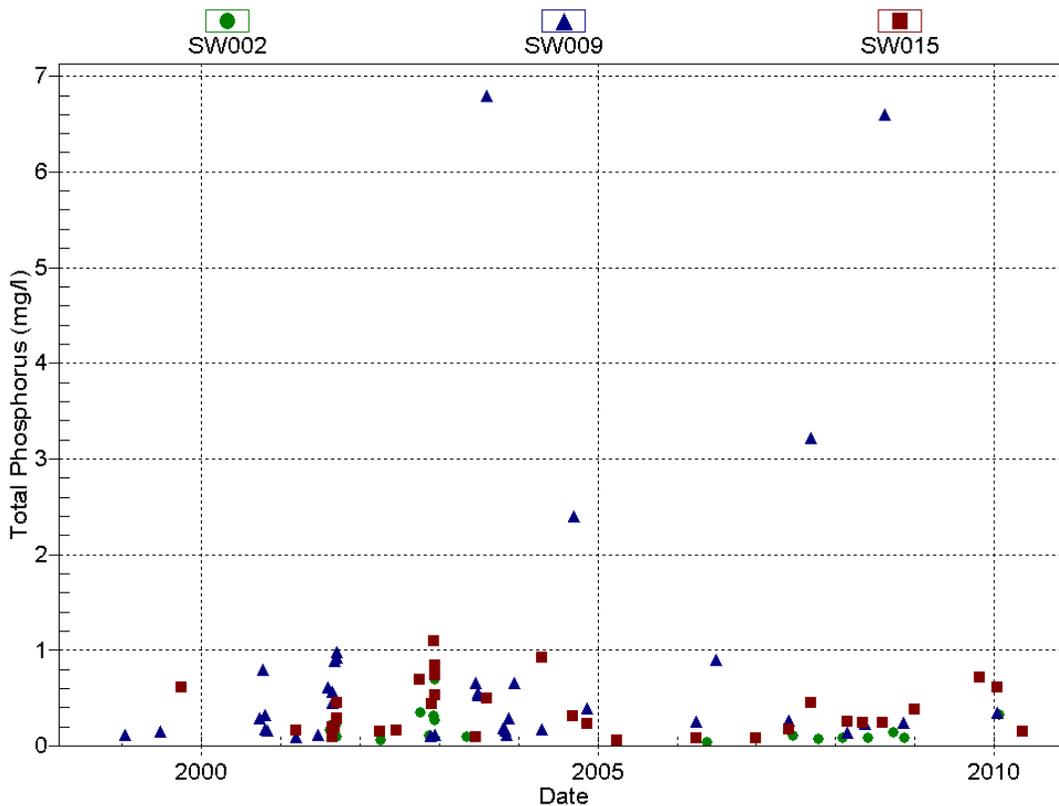


Figure 6.83 Total Phosphorus Results at Class AA Surface Water Sites: Period of Record through 2010

6.9.2. Total Nitrogen Results

Total nitrogen (milligrams per liter) is the sum of the various forms of nitrogen (nitrite, nitrate, and Total Kjeldahl Nitrogen). In the water quality samples collected on the Reservation, the form of nitrogen with the largest concentration was typically Total Kjeldahl Nitrogen (TKN), which is the sum of ammonia (NH₃) and organic nitrogen. As described above, total nitrogen was only collected at each of the five stations once during 2010 except for Site SW015 which was sampled twice. The total nitrogen concentration at Site SW002 was 0.36 mg/l, Site SW003 was 0.99 mg/l, Site SW006 was 0.19 mg/l, and SW009 was 0.38 mg/l. Site SW015 had the highest total nitrogen level of 1.6 mg/l, collected in January 2010. The total nitrogen concentration at Site SW015 during May 2010 was 0.86 mg/l. As shown in Figure 6.84, similar to TSS and total phosphorous, the highest total nitrogen values measured over the period of record through 2010 were at Site SW009 (Lummi River at Slater Road), and the lowest levels measured were at the marine water sites in Lummi Bay (SW002) and Portage Bay (SW006).

As shown in Figure 6.85, the Total Kjeldahl Nitrogen levels in the fresh water sites are all less than 10 mg/l. As reported in Dunne and Leopold (1978), in 1967 a committee of the American Water Works Association (AWWA) published the range of usual concentrations of nitrogen in discharges from various land uses. The usual concentration of nitrogen in rural runoff from agricultural lands is 1 to 70 mg/l and the usual concentration of nitrogen for rural runoff from non-agricultural lands is 0.1 to 0.5 mg/l. There was insufficient data for the AWWA committee to make an estimate for the usual range of nitrogen concentration where farm animal waste was the source, but the committee estimated a range of 18 to 20 mg/l of nitrogen for domestic waste. Based on the concentrations from the AWWA committee, the high levels of total nitrogen at Site SW009 indicate that dairy waste spills or manure applications during the wet season could be the source.

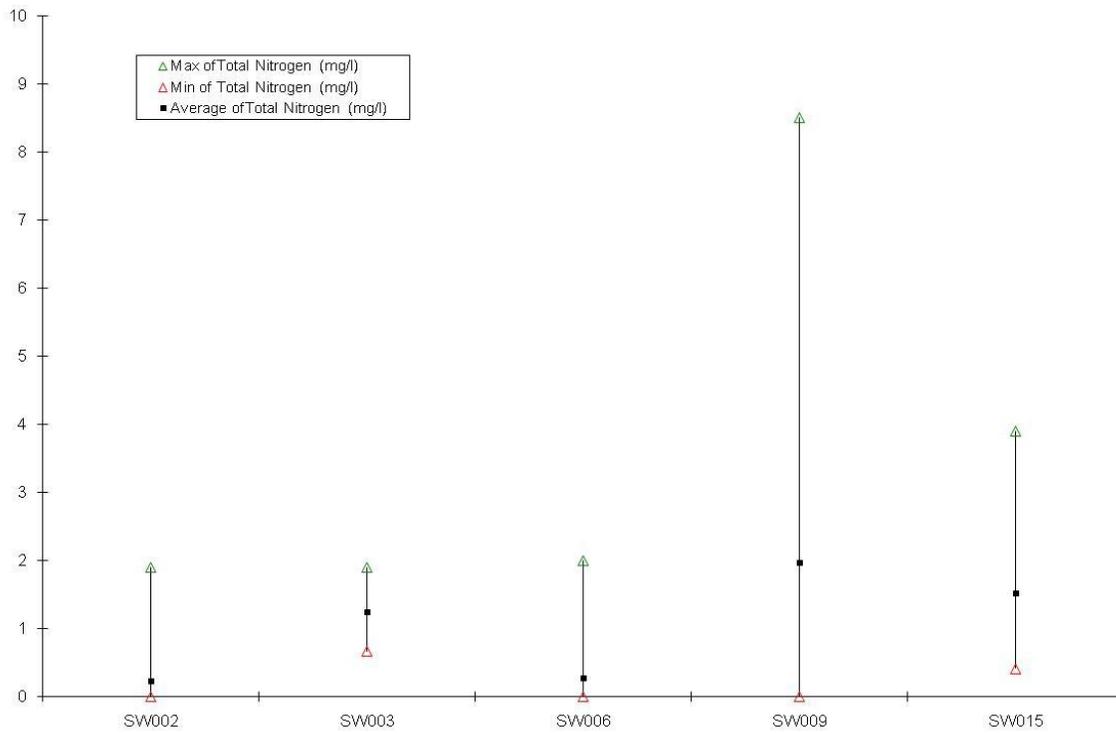


Figure 6.84 Total Nitrogen Results: Period of Record through 2010

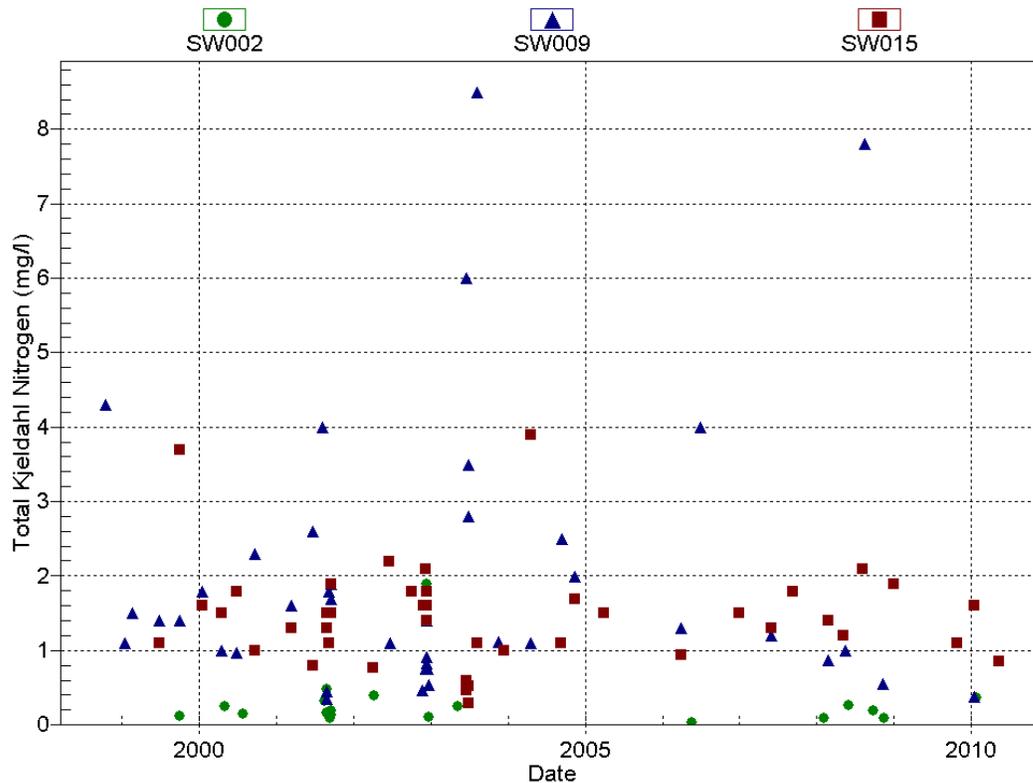


Figure 6.85 TKN Results at Class AA Surface Water Sites: Period of Record through 2010

7. DISCUSSION

More consistent and complete sampling was conducted during 2010 compared to the 2005 through 2007 period as a result of improved staff stability and associated equipment operation and maintenance. Reservation water quality remains complex due to the interaction of marine waters and fresh water, variable tidal conditions during sampling, and seasonal weather patterns. During the summer, upland sites can dry out or become saline, and are often heated due to solar radiation. Once the wet season starts, flow begins at the sites that dried out, and the water column becomes less saline. During the wet season, the waters tend to have dense populations of bacteria and low concentrations of dissolved oxygen (bacteria consume oxygen, which contribute to the lower dissolved oxygen levels). The cycle starts again at the beginning of the next dry season.

The water quality parameters at most of the sites during 2010 followed the trends of the 2003 to 2009 period: a recurrence of elevated bacteria levels, elevated temperatures, and low dissolved oxygen levels compared to the improvements in these parameters observed during 2000 and 2001. As shown in Table 7.1 and Table 7.2, the water quality at many sites during 2010 did not meet one or more of the water quality standards. None of the sample sites in the Lummi Bay Watershed achieved all of the water quality standards during 2010.

The mainstem of the Nooksack River at Marine Drive (SW118) showed a decrease in bacteria levels during 2010 compared to levels observed during 2003 through 2009. The Nooksack River met fecal coliform water quality standards and the TMDL standard during 2010, which has not been accomplished since 2007. In addition, the sample sites in Portage Bay (SW032, SW034, SW036, and SW038) met the Class A marine water quality standards for fecal coliform bacteria. Overall, a continuing trend observed in both the Bellingham and Lummi Bay watersheds was the introduction of fecal contamination into these bays from rivers, ditches, and streams originating off the Reservation. There are water quality and water quantity challenges in the Nooksack and Lummi River watersheds due to off-Reservation land development and agriculture. The primary data relationships used to form these conclusions were the elevated fecal coliform bacteria levels at fresh water sites, and the relatively low fecal coliform bacteria levels at marine water sites.

Dilution and deactivation from the saline waters in the bays decreased the bacteria densities from the levels found in the fresh water sample sites, but not enough to consistently avoid exceeding water quality criteria protective of shellfish harvesting. Figure 7.1 and Figure 7.2 show how the geometric mean of the fecal coliform bacteria density decreases moving downstream in the Lummi River and Jordan Creek watersheds, both of which discharge to Lummi Bay. Site SW009 shown in Figure 7.1 is located in the Lummi River channel at the northern boundary of the Reservation, Site SW008 is located where the Lummi River channel flows under the Hillaire Road Bridge, Site SW051 is where the Lummi River discharges to Lummi Bay, and sites DH288, DH040, and SW002 are located in Lummi Bay (see Figure 4.1). The geometric mean decreases along the Lummi River from 248 cfu/100 ml at the Reservation boundary (SW009) to 10 cfu/100 ml at the mouth of the Lummi River (SW051). Sites SW010 and SW011 shown in Figure 7.2 are located along the northern

Reservation boundary and contribute to Site SW003, which is located just upstream from where the channel flows under North Red River Road. Site SW053 is located just downstream from the tide gates at Lummi Bay at the mouth of Jordan Creek, and sites DH286 and DH287 are located in Lummi Bay. The geometric mean decreases along Jordan Creek from 89 cfu/100 ml and 162 cfu/100ml at the Reservation boundary (SW010 and SW011 respectively) to 28 cfu/100 ml at the mouth of Jordan Creek (SW053), and to 4 cfu/100 ml and 3 cfu/100 ml in Lummi Bay (DH286 and DH287 respectively).

Figure 7.3 and Figure 7.4 show how the 90th percentile of the fecal coliform bacteria density decreases moving downstream in the Lummi River and Jordan Creek watersheds. The 90th percentile decreases along the Lummi River from 2,400 cfu/100 ml at the Reservation boundary (SW009) to 67 cfu/100 ml at the mouth of the Lummi River (SW051). The 90th percentile decreases along the Jordan Creek from 2,400 cfu/100 ml and 1,200 cfu/100ml at the Reservation boundary (SW010 and SW011 respectively) to 210 cfu/100 ml at the mouth of Jordan Creek (SW053), to 32 cfu/100 ml and 20 cfu/100 ml in Lummi Bay (DH286 and DH287 respectively).

Figure 7.5 shows how the geometric mean of the fecal coliform bacteria density decreases moving from the Nooksack River main channel south into Portage/Bellingham Bay. The geometric mean decreases in the Nooksack River from 33 cfu/100 ml at the Reservation boundary (SW118) to 5 cfu/100 ml at the southeastern most DOH site in Portage Bay (DH49). Figure 7.6 depicts a similar decreasing trend for the 90th percentile of fecal coliform bacteria at the same sites in the Bellingham Bay watershed. The 90th percentile decreases from 113 cfu/100 ml in the Nooksack River at the Reservation boundary (SW118) to 43 cfu/100 ml at the southeastern most DOH site in Portage Bay (DH49).

Overall, when comparing fecal coliform densities in the two major watersheds on the Reservation (Lummi Bay and Portage Bay), water quality sites in the Lummi Bay watershed have a higher geometric mean and 90th percentile than sites in the Portage Bay watershed. In Figure 7.1 and Figure 7.2, which depict changes in fecal coliform bacteria geometric mean moving downstream in the Lummi Bay watershed, the y-axis (fecal coliform bacteria densities) ranges from 0 – 300 cfu/100 ml. In comparison, Figure 7.5 shows Portage Bay watershed fecal coliform geometric means ranging between 0 – 35 cfu/100 ml. Similar results are observed in the 90th percentile calculations for fecal coliform bacteria. Sample sites in the Lummi Bay watershed range between 0 – 3,000 cfu/100 ml and sample sites in the Portage Bay watershed range from 0 – 200 cfu/100 ml. The poor water quality in the Lummi Bay watershed is a major concern due to the potential for new closures of important tribal shellfish beds.

Table 7.1 Extent Lummi Bay Waters Meet Lummi Water Quality Standards and Designated Uses are Supported During 2010

	Location	Dissolved Oxygen (mg/L) Assessment	Temperature (°C) Assessment	pH Assessment	Fecal Coliform Bacteria (cfu/100ml) Assessment	Enterococcus (cfu/100ml) Assessment	Full Support
LUMMI BAY WATERSHED	Jordan Creek						NO
	SW010	X	X	X	X	X	
	SW011	X	X	X	X	X	
	SW003	X	X	•	X	X	
	SW053	X	X	X	X	X	
	Lummi River						NO
	SW009	X	X	X	X	X	
	SW008	X	X	•	X	X	
	SW051	X	X	X	X	X	
	SW055	X	X	X	X	•	
	SW058	X	•	X	X	X	
	Smuggler's Slough						NO
	SW072	X	X	X	X	X	
	SW015	X	X	X	X	X	
	SW059	X	X	X	X	X	
	SW056	•	X	•	X	•	
	Schell Creek						NO
	SW012	X	X	•	X	X	
	Onion Creek						NO
	SW014	X	•	X	X	X	
	Seapond Creek						NO
	SW029	X	•	X	X	X	
	East Reservation Boundary						NO
	SW016	X	X	•	X	X	
	SW017	X	X	•	X	X	
	Sandy Point Channel						NO
	SW001	X	X	X	•	•	
	SW019	•	X	X	X	•	
	Lummi Bay						NO
	SW002	•	X	•	•	•	
	SW022	•	X	•	•	•	
	SW052	•	X	•	•	•	
	DH38	•	X	•	•	N/A	
	DH39	•	X	•	•	N/A	
	DH40	•	X	•	•	N/A	
	DH41	•	X	•	•	N/A	
	DH42	•	X	•	•	N/A	
	DH43	•	X	•	•	N/A	
	DH44	•	X	•	•	N/A	
	DH45	X	X	•	•	N/A	
	DH285	•	X	•	•	N/A	
	DH286	X	X	•	•	N/A	
DH287	•	X	•	•	N/A		
DH288	•	X	•	•	N/A		

X = standard not achieved; • = standard achieved; N/A = Not determined

Table 7.2 Extent Bellingham Bay Waters Meet Lummi Water Quality Standards and Designated Uses are Supported During 2010

	Location	Dissolved Oxygen (mg/L) Assessment	Temperature (°C) Assessment	pH Assessment	Fecal Coliform Bacteria (cfu/100ml) Assessment	Enterococcus (cfu/100ml) Assessment	Full Support
BELLINGHAM BAY WATERSHED	Nooksack River						NO
	SW118	X	X	•	•	X	
	Kwina Slough						NO
	SW007	X	•	•	X	X	
	Lummi Shore Road Watershed						NO
	SW031	X	•	X	•	•	
	SW032	•	X	X	•	X	
	SW033	X	•	X	X	•	
	SW034	•	X	X	•	•	
	SW035	•	•	X	•	•	
	SW036	•	X	X	•	•	
	SW037	•	•	X	•	•	
	SW038	•	X	•	•	•	
	SW039	•	X	X	•	X	
	Portage Island						NO
	SW024	N/A	N/A	N/A	N/A	N/A	
	SW025	•	•	•	•	•	
	SW026	X	X	•	•	X	
	SW027	•	X	•	•	X	
	SW028	X	X	•	X	X	
	Portage Bay						NO
	SW006	•	X	•	•	•	
	SW023	•	X	•	X	X	
	SW030	•	X	X	X	X	
	DH49	N/A	•	N/A	•	N/A	
	DH50	N/A	•	N/A	•	N/A	
	DH51	N/A	•	N/A	X	N/A	
	DH52	N/A	•	N/A	X	N/A	
	DH53	N/A	•	N/A	•	N/A	
	DH54	N/A	•	N/A	X	N/A	
	DH55	N/A	•	N/A	•	N/A	
	DH57	N/A	•	N/A	X	N/A	
DH58	N/A	•	N/A	•	N/A		
DH271	N/A	•	N/A	•	N/A		
DH272	N/A	•	N/A	•	N/A		

X – Water quality parameter does not meet the Lummi Water Quality Standard

• – Water quality parameter meets the Lummi Water Quality Standard

N/A – Water quality parameter is not measured as part of the Program

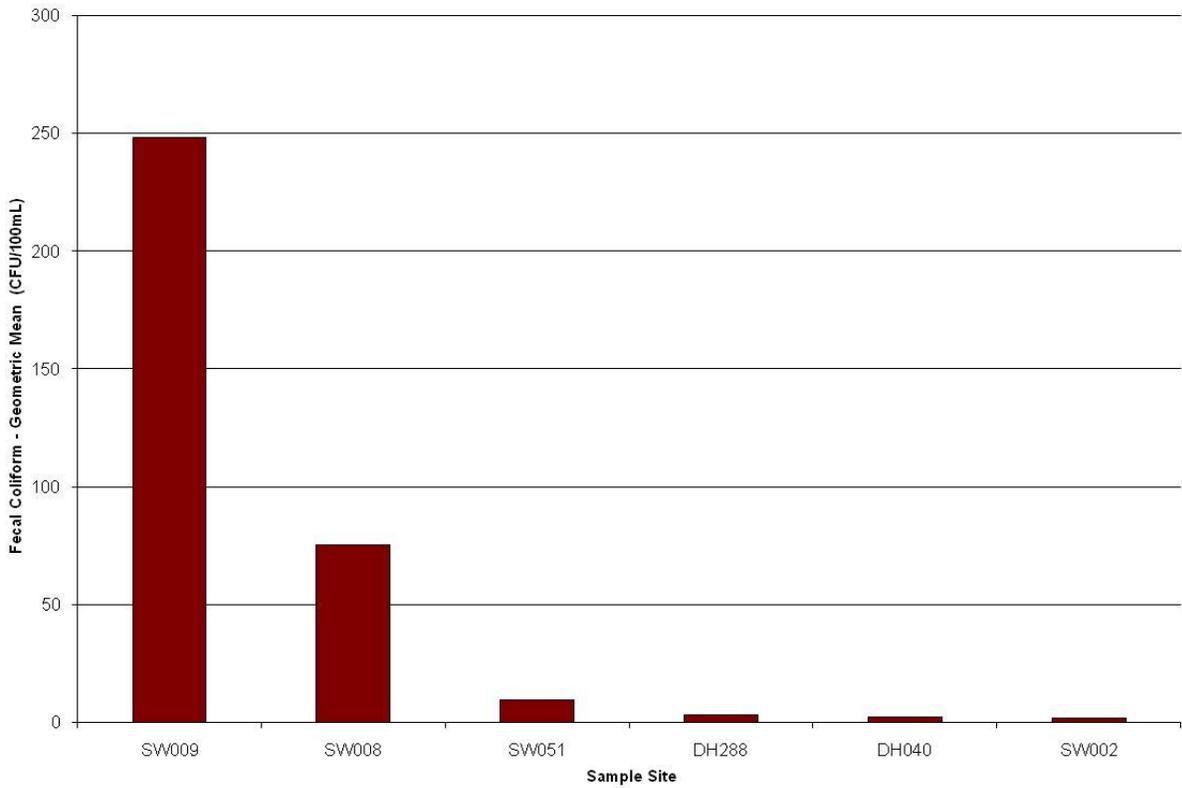


Figure 7.1 Changes in the Geometric Mean of Fecal Coliform Bacteria Sample Results in the Lummi River and Lummi Bay: Period of Record through 2010

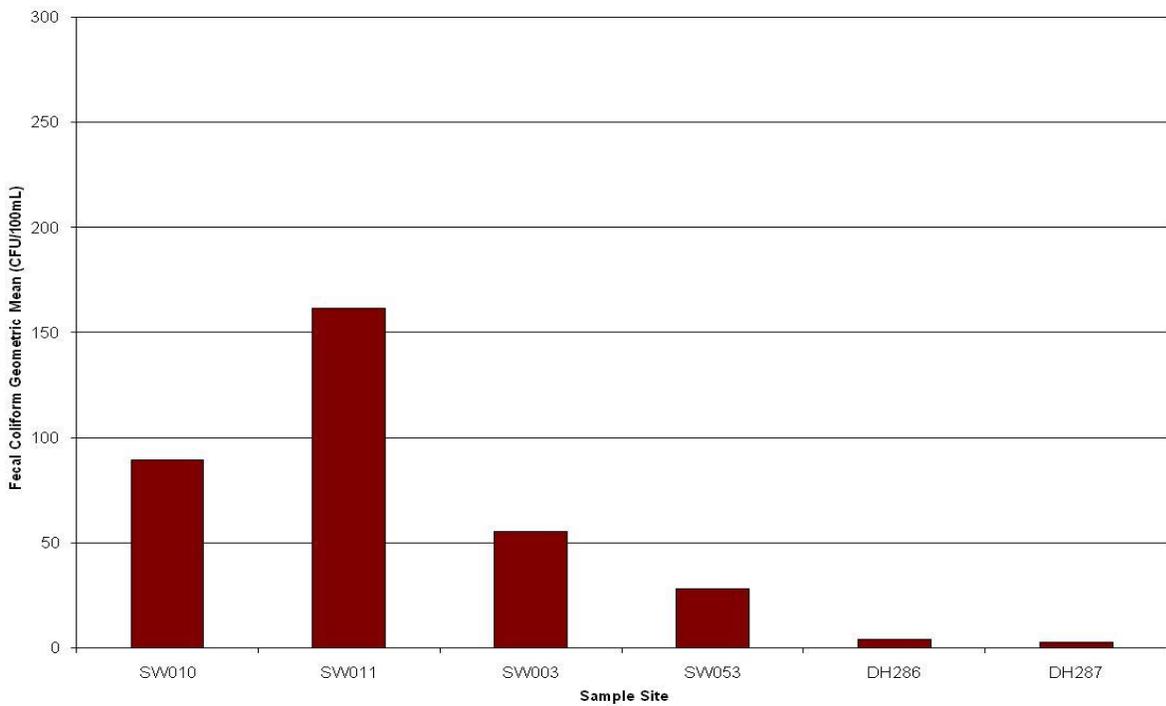


Figure 7.2 Changes in the Geometric Mean of Fecal Coliform Bacteria Sample Results in the Jordan Creek/Lummi Bay Watershed: Period of Record through 2010

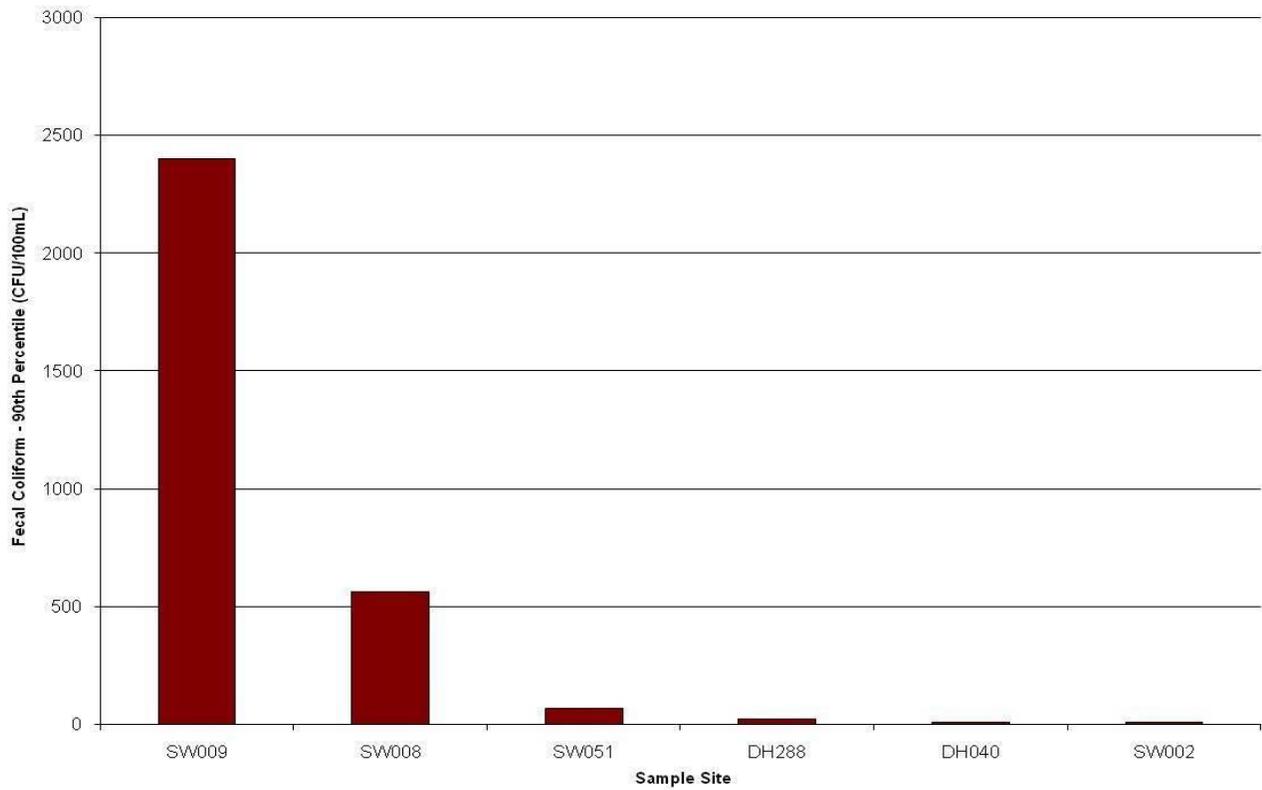


Figure 7.3 Changes in the 90th Percentile of Fecal Coliform Bacteria Sample Results in the Lummi River and Lummi Bay: Period of Record through 2010

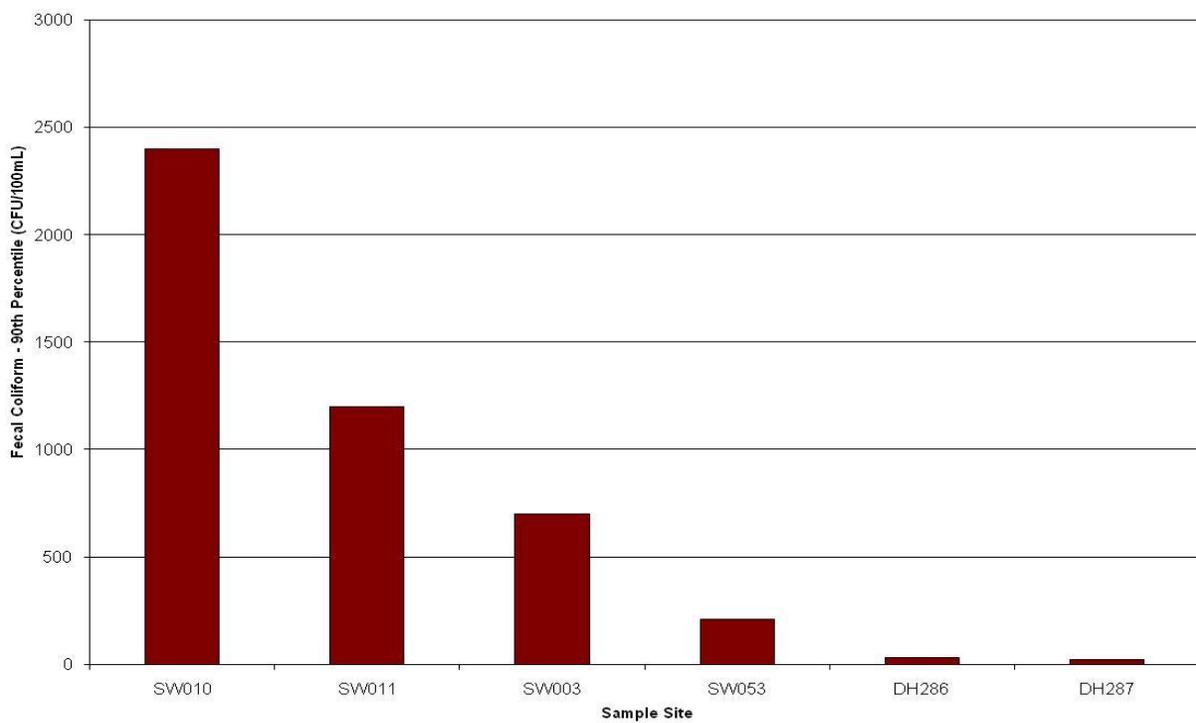


Figure 7.4 Changes in the 90th Percentile of Fecal Coliform Bacteria Sample Results in the Jordan Creek/Lummi Bay Watershed: Period of Record through 2010

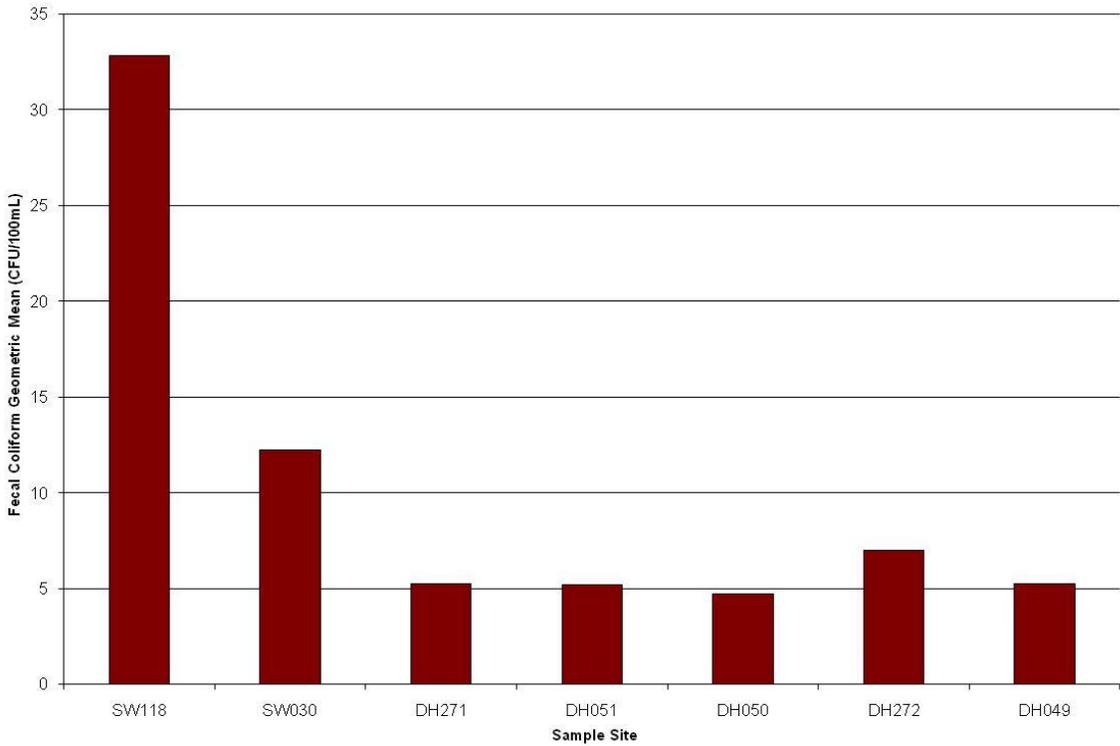


Figure 7.5 Changes in the Geometric Mean of Fecal Coliform Bacteria Sample Results in the Nooksack River/Bellingham Watershed: Period of Record through 2010

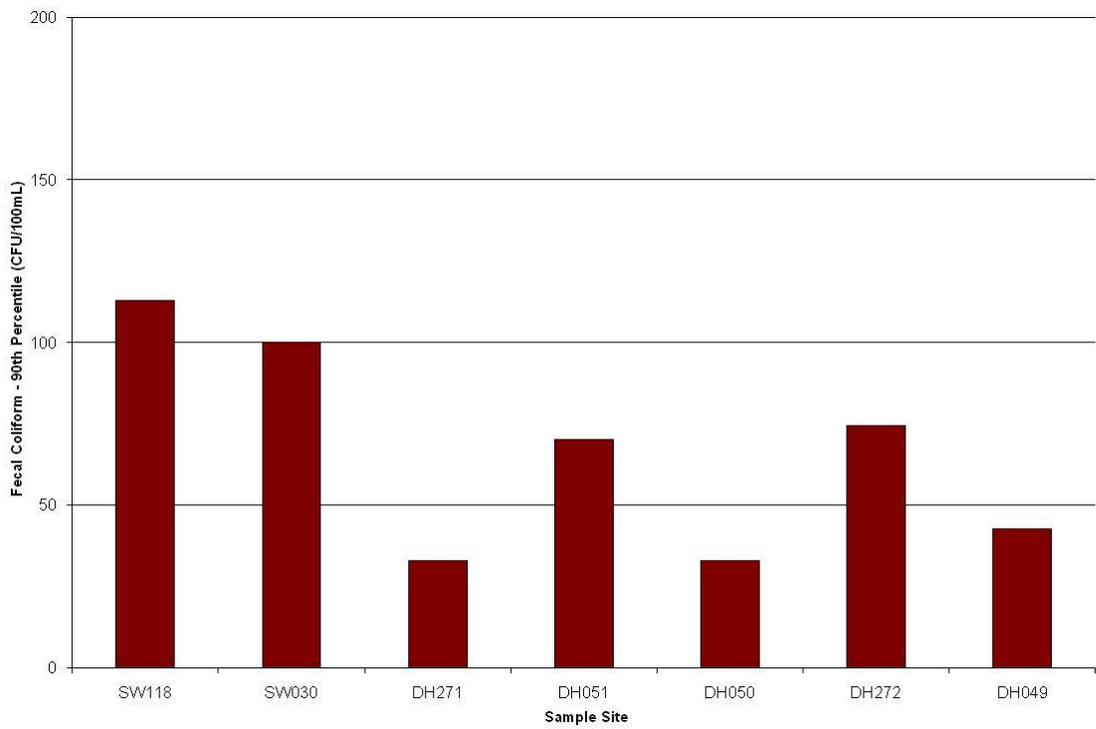


Figure 7.6 Changes in the 90th Percentile of Fecal Coliform Bacteria Sample Results in the Nooksack River/Bellingham Bay Watershed: Period of Record through 2010

7.1. Causes and Sources of Lummi Waters Not Supporting Designated Uses

None of the waters in the Lummi Bay watershed and the Portage Bay watershed support their designated uses because of increased fecal coliform densities, increased temperatures, low dissolved oxygen levels, and/or pH levels (Table 7.1 and Table 7.2). In the Lummi Bay watershed, temperature, dissolved oxygen, and fecal coliform were the most common reason that designated uses are not supported. The primary source of these impairments in the Lummi Bay watershed is off-Reservation agricultural practices. In the Portage Bay watershed, fecal coliform bacteria and enterococcus were the most common causes of waters not supporting their designated use. Again, off-Reservation agricultural land uses in is the major source of high fecal coliform densities, particularly the Nooksack River watershed, which drains the majority of the agricultural lands in lower Whatcom County.

Fecal coliform bacteria are of particular importance because they are the indicator organism used in the National Shellfish Sanitation Program (NSSP) to classify shellfish beds as suitable for commercial harvest. Both the Lummi and Nooksack River watersheds contain land uses that contribute fecal coliform bacteria to surface waters. As shown in Figure 7.1 through Figure 7.4, the highest fecal coliform bacteria levels are measured along the Reservation boundary, indicating an off-Reservation source. All or portions of approximately 220 acres of tribal shellfish beds in Portage Bay were closed to commercial harvest over the November 1996 to May 2006 period due to bacterial contamination attributed to poor dairy nutrient management practices in the Nooksack River (DOH 1997, Ecology 2000).

The decrease in fecal coliform bacteria densities during 2000 and 2001 in both the Nooksack River and Portage Bay was a positive indication that fecal coliform bacteria pollution prevention efforts were succeeding in the Nooksack River watershed. However, fecal coliform bacteria levels rose again in these water bodies during the 2003 to 2008 period. During 2008 through 2010, the mainstem of the Nooksack River (SW118) showed a continual decrease in fecal coliform bacteria levels. During 2010, the Nooksack River met fecal coliform water quality standards where it flowed onto the Reservation. Along the Lummi Peninsula nearshore areas of Portage Bay, storm water during the onset of the wet season typically contains elevated fecal coliform bacteria levels, but flows are very low. By the time the flows increase, fecal coliform bacteria levels are substantially reduced. Intensive shoreline sampling over the 1998 through 2001 period demonstrated that local sources of fecal coliform bacteria are not a significant source of fecal contamination to Portage Bay (LWRD 1999, LWRD 2006c, LWRD 2006d). Small fresh water streams on Portage Island contain elevated fecal coliform bacteria levels, but as described above, flows are very low and do not appear to be a significant source of fecal contamination to Portage Bay. A herd of cattle present on the uninhabited Portage Island is thought to be the main source of high fecal coliform bacteria concentrations in the fresh water streams. Removal of the cattle is currently being conducted and should be completed during 2011, which should reduce the fecal coliform bacteria entering Portage Bay from Portage Island.

Land use practices in the Lummi River watershed are likely the primary cause of the elevated bacteria levels, elevated temperatures, and depressed dissolved oxygen values in the surface waters along the Reservation boundary. Fecal coliform bacteria levels well above the Lummi Nation Surface Water Quality Standards were common along the Reservation boundary sample

sites in the early and mid-1990s, and had been decreasing during 2001 and 2002. However, during the 2003 through 2010 period, bacteria levels at many sites along the boundary increased again.

Just as the fresh water system influences the marine waters in the bays, the marine waters influence the fresh water system with upstream flows during high tides. This is especially notable in the Lummi Bay watershed where saline waters reached to the northern Reservation boundary.

As shown in Table 7.1 and Table 7.2, the collected data suggest that 20 sample sites throughout the Reservation achieved the water temperatures standards during 2010. As noted previously, continuous water temperature data are not collected at most sites so a direct compliance assessment is not possible at most sites. However, the 2010 results are comparable to results from previous years and reflect improved conditions relative to 2009 when the temperature standard was achieved at only one site. Some of these exceedences are caused by naturally occurring conditions, such as Site SW002 in Lummi Bay, where the tide flat is exposed to full sunlight in the summer. However, at other sites these exceedences are likely due to human-caused factors such as the removal of riparian vegetation and/or drainage alterations that decrease the amount of ground water available to moderate surface water temperatures in the summer. The extent to which anthropogenic influences have contributed to elevated water temperatures at the various sample sites has not been established.

Dissolved oxygen levels also vary considerably throughout the year, and not always inversely to temperature. As shown in Table 7.1 and Table 7.2, the majority of water bodies do not achieve the dissolved oxygen (mg/l) water quality standards except Portage Bay and Lummi Bay. At some sites, the deviation of dissolved oxygen and temperature from their equilibrium appears to be due to elevated primary production of oxygen by algae that increases the dissolved oxygen levels concurrent with elevated temperatures. The dissolved oxygen values could range from low to high to low again over a 24-hour period. To explore this phenomenon further, water quality should be sampled several times a day over the course of several days at representative sites.

Other causes of high dissolved oxygen levels concurring with elevated water temperatures may be due to wave entrainment of air or the water heating more rapidly than the rate at which dissolved oxygen maintains equilibrium concentrations in water. In places such as Lummi Bay, air entrainment, primary production, and rapid heating are likely occurring and contributing to elevated dissolved oxygen values. In many places on the Reservation, dissolved oxygen values fall below applicable water quality criteria. Similar to temperature, there are places where extremely low dissolved oxygen values could be due to naturally occurring conditions (e.g., an area without shade where the streambed is in the photic zone and flows are generally low to stagnant). At sites where human created or induced changes occurred (e.g., clearing of vegetation, drainage of ground water, increased nutrient loading), the extremes of dissolved oxygen variation have likely been increased due to the human activity setting the stage for increased primary production. Similarly, high bacteria densities, often created by anthropogenic activities, can cause drops in dissolved oxygen concentrations as the bacteria consume oxygen while metabolizing. The extent to which anthropogenic influences have contributed to depressed dissolved oxygen levels at the various sample sites has not been estimated.

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8. SUMMARY AND CONCLUSIONS

The goals of the Lummi Nation Surface Water Quality Monitoring Program are to document ambient water quality and water quality trends on the Lummi Indian Reservation (Reservation), evaluate regulatory compliance of waters flowing through and onto the Reservation including compliance with Lummi Nation Surface Water Quality Standards (LWRD 2008a), and support the development and implementation of water quality regulatory programs on the Reservation.

This report presents the surface water quality data collected during calendar year 2010, compares the 2010 results to data from 1993 to 2009, presents interpretations of these data with respect to the Program goals, and provides the U.S. Environmental Protection Agency (EPA) documentation required pursuant to the *Final Guidance of Awards of Grants to Indian Tribes under Section 106 of the Clean Water Act* (EPA 2006).

Water quality on the Reservation is complex for a number of reasons including the Reservation location in the estuaries of the Lummi River and the Nooksack River where marine and fresh waters interact, the approximately 38 miles of marine shoreline and 7,000 acres of tidelands, and the weather patterns that influence the water quality at the sampling sites.

The water quality parameters measured during calendar year 2010 were largely similar to the measured water quality parameters during previous years with a few exceptions. The water quality parameters at the monitoring sites during 2010 generally followed the trends of the time period 2003 to 2009. That is, generally elevated bacteria levels, higher temperatures, and lower dissolved oxygen levels compared to the Lummi Nation Water Quality Standards (LWRD 2008a). Fecal coliform bacteria levels in the mainstem of the Nooksack River at the Reservation border (SW118) improved during 2010 compared to the trends of 2003 through 2007. During 2010, fecal coliform bacteria levels at Site SW118 were lower than the Total Maximum Daily Load (TMDL) target of a geometric mean of 39 coliform forming units/100 ml established for the lower Nooksack River (Ecology 2000 and 2002), and the 90th percentile water quality standard for Class AA fresh water bodies. The water quality parameters are generally more degraded in the sites further inland, and gradually improve downstream towards the marine waters on the Reservation.

The marine waters of Lummi Bay and the Sandy Point Marina continue to have relatively good quality, while the surface waters within the Lummi River watershed continue to have the poorest water quality of the sites sampled on the Reservation. Sampling of the Nooksack River indicated variable water quality with elevated fecal coliform bacteria readings during 2010 that are a cause of concern even though improvements were observed compared to the 2003 through 2007 period. Achievement of the fecal coliform water quality standards and TMDL goals in the Nooksack River where it flows onto the Reservation and the decreasing levels of fecal coliform bacteria in Portage Bay are signs that technical assistance and enforcement actions in the Nooksack River Basin are helping improve the water quality. The continuing poor water quality in the Lummi River and tributaries to Lummi Bay, particularly with respect to increased fecal coliform bacteria contamination, is a major concern due to the potential for new closures of important tribal shellfish beds. The members of the Lummi Nation use these shellfish beds for ceremonial, subsistence, and commercial purposes.

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APPENDIX A

Water Quality Monitoring Data for 2010

Table A.1 2010 Selected Water Quality Results

Run Date	Site Number	Air Temperature (deg C)	Alkalinity (mg/l)	Ammonia (mg/l)	Arsenic (mg/l)	Biochemical Oxygen Demand (mg/l)	Chemical Oxygen Demand (mg/l)	Chlorophyll a (ug/l)	Chromium (mg/l)	Copper (mg/l)	Diesel Range Plus (mg/l)	E. coli (cfu/100ml)	Enterococcus (cfu/100ml)
1/25/2010	DH038	10											
3/3/2010	DH038	8											
5/13/2010	DH038	15											
7/12/2010	DH038	15.5											
9/27/2010	DH038	17											
1/8/2010	DH038	8.5											
12/14/2010	DH038	5.5											
1/25/2010	DH039	9											
3/3/2010	DH039	8											
5/13/2010	DH039	16											
7/12/2010	DH039	17											
9/27/2010	DH039	17											
11/8/2010	DH039	8											
12/14/2010	DH039	5.5											
1/25/2010	DH040	10											
3/3/2010	DH040	8											
5/13/2010	DH040	15.5											
7/12/2010	DH040	16.75											
9/27/2010	DH040	17											
11/8/2010	DH040	7.5											
12/14/2010	DH040	6											
1/25/2010	DH041	9											
3/3/2010	DH041	8											
5/13/2010	DH041	17											
7/12/2010	DH041	16.5											
9/27/2010	DH041	17											
11/8/2010	DH041	8											
1/25/2010	DH042	10											
3/3/2010	DH042	8											
5/13/2010	DH042	18											
7/12/2010	DH042	17											
9/27/2010	DH042	19											
11/8/2010	DH042	8											
1/25/2010	DH043	10											
3/3/2010	DH043	8											
5/13/2010	DH043	15											
7/12/2010	DH043	17											
9/27/2010	DH043	20											
11/8/2010	DH043	8											
1/25/2010	DH044	10											
3/3/2010	DH044	12											
5/13/2010	DH044	14											
7/12/2010	DH044	14											
9/27/2010	DH044	20											

Table A.1 2010 Selected Water Quality Results

Run Date	Site Number	Air Temperature (deg C)	Alkalinity (mg/l)	Ammonia (mg/l)	Arsenic (mg/l)	Biochemical Oxygen Demand (mg/l)	Chemical Oxygen Demand (mg/l)	Chlorophyll a (ug/l)	Chromium (mg/l)	Copper (mg/l)	Diesel Range Plus (mg/l)	E. coli (cfu/100ml)	Enterococcus (cfu/100ml)
12/14/2010	DH044	5.75											
1/25/2010	DH045	12											
3/3/2010	DH045	10											
5/13/2010	DH045	15											
7/12/2010	DH045	15											
9/27/2010	DH045	19											
11/8/2010	DH045	9											
12/14/2010	DH045	5.25											
1/27/2010	DH048												
3/24/2010	DH048												
5/26/2010	DH048												
7/20/2010	DH048												
9/14/2010	DH048												
11/16/2010	DH048												
1/27/2010	DH049												
3/24/2010	DH049												
5/26/2010	DH049												
7/20/2010	DH049												
9/14/2010	DH049												
11/16/2010	DH049												
12/14/2010	DH049	5											
1/27/2010	DH050												
3/24/2010	DH050												
5/26/2010	DH050												
7/20/2010	DH050												
9/14/2010	DH050												
11/16/2010	DH050												
1/27/2010	DH051												
3/24/2010	DH051												
5/26/2010	DH051												
7/20/2010	DH051												
9/14/2010	DH051												
11/16/2010	DH051												
1/27/2010	DH052												
3/24/2010	DH052												
5/26/2010	DH052												
7/20/2010	DH052												
9/14/2010	DH052												
11/16/2010	DH052												
12/14/2010	DH052	5											
1/27/2010	DH053												
3/24/2010	DH053												
5/26/2010	DH053												
7/20/2010	DH053												

Table A.1 2010 Selected Water Quality Results

Run Date	Site Number	Air Temperature (deg C)	Alkalinity (mg/l)	Ammonia (mg/l)	Arsenic (mg/l)	Biochemical Oxygen Demand (mg/l)	Chemical Oxygen Demand (mg/l)	Chlorophyll a (ug/l)	Chromium (mg/l)	Copper (mg/l)	Diesel Range Plus (mg/l)	E. coli (cfu/100ml)	Enterococcus (cfu/100ml)
9/14/2010	DH053												
11/16/2010	DH053												
1/27/2010	DH054												
3/24/2010	DH054												
5/26/2010	DH054												
7/20/2010	DH054												
9/14/2010	DH054												
11/16/2010	DH054												
1/27/2010	DH055												
3/24/2010	DH055												
5/26/2010	DH055												
7/20/2010	DH055												
9/14/2010	DH055												
11/16/2010	DH055												
1/27/2010	DH057												
3/24/2010	DH057												
5/26/2010	DH057												
7/20/2010	DH057												
9/14/2010	DH057												
11/16/2010	DH057												
12/14/2010	DH057	4.5											
1/27/2010	DH058												
3/24/2010	DH058												
5/26/2010	DH058												
7/20/2010	DH058												
9/14/2010	DH058												
11/16/2010	DH058												
1/27/2010	DH271												
3/24/2010	DH271												
5/26/2010	DH271												
7/20/2010	DH271												
9/14/2010	DH271												
12/14/2010	DH271	5											
1/27/2010	DH272												
3/24/2010	DH272												
5/26/2010	DH272												
7/20/2010	DH272												
9/14/2010	DH272												
11/16/2010	DH272												
1/25/2010	DH285	9											
3/23/2010	DH285	8											
5/13/2010	DH285	15.5											
7/12/2010	DH285	15											
9/27/2010	DH285	17											

Table A.1 2010 Selected Water Quality Results

Run Date	Site Number	Air Temperature (deg C)	Alkalinity (mg/l)	Ammonia (mg/l)	Arsenic (mg/l)	Biochemical Oxygen Demand (mg/l)	Chemical Oxygen Demand (mg/l)	Chlorophyll a (ug/l)	Chromium (mg/l)	Copper (mg/l)	Diesel Range Plus (mg/l)	E. coli (cfu/100ml)	Enterococcus (cfu/100ml)
11/8/2010	DH285	8											
12/14/2010	DH285	5											
1/25/2010	DH286	8											
3/3/2010	DH286	8											
5/13/2010	DH286	17											
7/12/2010	DH286	16											
9/27/2010	DH286	17											
11/8/2010	DH286	8											
12/14/2010	DH286	5											
1/25/2010	DH287	10											
3/3/2010	DH287	8.5											
5/13/2010	DH287	16											
7/12/2010	DH287	15											
9/27/2010	DH287	16.5											
11/8/2010	DH287	8											
12/14/2010	DH287	5.5											
1/25/2010	DH288	8											
3/3/2010	DH288	9											
5/13/2010	DH288	18											
7/12/2010	DH288	15											
9/27/2010	DH288	17											
11/8/2010	DH288	6.5											
12/14/2010	DH288	4											
1/26/2010	SW001	10			0.0045					0.0045	0.09	1.9	9
3/15/2010	SW001	11.5										1.9	9
4/16/2010	SW001	10										1.9	9
5/7/2010	SW001	13.25										1.9	9
6/8/2010	SW001	13										1.9	9
7/19/2010	SW001	21										4	9
8/17/2010	SW001	24										6	9
9/7/2010	SW001	15										2	10
10/12/2010	SW001	17										6	10
11/9/2010	SW001	6.5										10	20
1/26/2010	SW002	11.5	100	0.06		1.8		4.3				1.9	9
2/9/2010	SW002	9										1.9	9
3/15/2010	SW002	11										1.9	9
4/16/2010	SW002	8										1.9	9
5/7/2010	SW002	13										1.9	9
6/8/2010	SW002	18										1.9	9
7/19/2010	SW002	19										1.9	9
8/17/2010	SW002	20										1.9	9
9/7/2010	SW002	17										2	9
10/12/2010	SW002	15										1.9	9

Table A.1 2010 Selected Water Quality Results

Run Date	Site Number	Air Temperature (deg C)	Alkalinity (mg/l)	Ammonia (mg/l)	Arsenic (mg/l)	Biochemical Oxygen Demand (mg/l)	Chemical Oxygen Demand (mg/l)	Chlorophyll a (ug/l)	Chromium (mg/l)	Copper (mg/l)	Diesel Range Plus (mg/l)	E. coli (cfu/100ml)	Enterococcus (cfu/100ml)
1/9/2010	SW002	7.75										2	9
1/14/2010	SW003	10	46	0.12		2		9.6				26	31
2/16/2010	SW003	15										720	1400
3/10/2010	SW003	9										6	9
4/27/2010	SW003	19.5										42	53
5/25/2010	SW003	19.5										58	9
6/22/2010	SW003	25										76	53
7/29/2010	SW003	18										360	10
8/25/2010	SW003	27										12	10
9/9/2010	SW003	23										2	9
10/28/2010	SW003	9										54	53
11/23/2010	SW003											66	87
1/13/2010	SW004	14										26	20
1/14/2010	SW004	8										40	75
1/26/2010	SW006	8	90	0.05		1.8	140	0.27				1.9	9
2/9/2010	SW006	8.5										1.9	9
3/15/2010	SW006	15										2	9
4/6/2010	SW006	10										1.9	9
5/7/2010	SW006	13										2	9
6/8/2010	SW006	16.5										2	9
7/19/2010	SW006	23										1.9	9
8/17/2010	SW006	20.25										1.9	9
9/7/2010	SW006	15										1.9	9
10/12/2010	SW006	19										38	290
11/9/2010	SW006	11										8	10
1/27/2010	SW007	9										10	20
2/17/2010	SW007	10										46	10
3/24/2010	SW007	15.25										20	9
4/28/2010	SW007	16										26	9
5/26/2010	SW007	13.5										42	31
6/29/2010	SW007	16										28	9
7/20/2010	SW007	20										26	9
8/31/2010	SW007	15.25										130	210
9/14/2010	SW007	19										110	270
10/13/2010	SW007	13.25										28	9
11/10/2010	SW007	13										8	10
1/14/2010	SW008	9.5										1.9	87
2/16/2010	SW008	12										160	99
3/10/2010	SW008	8										14	10
4/27/2010	SW008	18										600	120
5/25/2010	SW008	19										88	87
6/22/2010	SW008	24										380	87
7/29/2010	SW008	21										2	560
8/25/2010	SW008	22										12	9

Table A.1 2010 Selected Water Quality Results

Run Date	Site Number	Air Temperature (deg C)	Alkalinity (mg/l)	Ammonia (mg/l)	Arsenic (mg/l)	Biochemical Oxygen Demand (mg/l)	Chemical Oxygen Demand (mg/l)	Chlorophyll a (ug/l)	Chromium (mg/l)	Copper (mg/l)	Diesel Range Plus (mg/l)	E. coli (cfu/100ml)	Enterococcus (cfu/100ml)
9/9/2010	SW008	20										360	42
10/26/2010	SW008	9										62	190
1/14/2010	SW009	7.5	52	0.08		2		3.2				22	87
2/16/2010	SW009	12.5										140	64
3/10/2010	SW009	8										20	10
4/27/2010	SW009	17										160	42
5/25/2010	SW009	17.5										500	160
6/22/2010	SW009	27.5										260	250
7/29/2010	SW009	22										180	620
8/25/2010	SW009	30										54	2000
9/9/2010	SW009	19										2100	1200
10/26/2010	SW009	10										500	2000
1/14/2010	SW010	9										36	42
2/16/2010	SW010	12										48	31
3/10/2010	SW010	7.5										26	9
5/25/2010	SW010	19.5										72	9
6/22/2010	SW010	24										120	280
7/29/2010	SW010	21										6	10
8/25/2010	SW010	28										100	270
9/9/2010	SW010	23										1000	87
10/26/2010	SW010	9										8	75
1/14/2010	SW011	9.5										88	53
2/16/2010	SW011	10										420	2000
3/10/2010	SW011	9.5										52	31
4/27/2010	SW011	16.5										220	120
5/25/2010	SW011	19.5										520	53
6/22/2010	SW011	20.5										1200	590
7/29/2010	SW011	21										10	9
8/25/2010	SW011	21.5										2400	2000
9/9/2010	SW011	17										1700	1700
10/26/2010	SW011	9										620	1100
1/12/2010	SW011											56	42
1/14/2010	SW012	8										16	9
2/16/2010	SW012	12.5										32	87
3/10/2010	SW012	7.75										62	20
4/27/2010	SW012	17										60	9
5/25/2010	SW012	18										340	87
6/22/2010	SW012	28										280	99
7/29/2010	SW012	20										36	9
8/25/2010	SW012	27.5										60	20
9/9/2010	SW012	19.5										200	99
10/26/2010	SW012	9.5										78	53
11/23/2010	SW012											22	10
1/14/2010	SW013	8										1.9	10

Table A.1 2010 Selected Water Quality Results

Run Date	Site Number	Air Temperature (deg C)	Alkalinity (mg/l)	Ammonia (mg/l)	Arsenic (mg/l)	Biochemical Oxygen Demand (mg/l)	Chemical Oxygen Demand (mg/l)	Chlorophyll a (ug/l)	Chromium (mg/l)	Copper (mg/l)	Diesel Range Plus (mg/l)	E. coli (cfu/100ml)	Enterococcus (cfu/100ml)
2/16/2010	SW013	13										90	64
3/10/2010	SW013	8										8.9	31
4/27/2010	SW013	17										32	31
5/25/2010	SW013	18										22	9
6/22/2010	SW013	29										44	53
7/29/2010	SW013	23										120	20
8/25/2010	SW013	27										50	120
9/9/2010	SW013	21										13	2000
10/26/2010	SW013	9.5										98	180
1/14/2010	SW014	9							0.012	0.002	0.09	1.9	10
2/16/2010	SW014	10.5										66	99
3/10/2010	SW014	8										22	140
4/27/2010	SW014	15.5										280	10
5/25/2010	SW014	20										800	700
6/22/2010	SW014	26										56	42
9/9/2010	SW014	17										64	110
10/26/2010	SW014	9										66	42
11/23/2010	SW014											92	9
1/13/2010	SW015	10.5	52	0.045		3.3	59.8	29				30	10
2/8/2010	SW015	13										6	9
3/29/2010	SW015	11										800	42
4/14/2010	SW015	15										8	9
5/12/2010	SW015	21	184	0.11		1.9	42.9	27				6	9
6/28/2010	SW015	19.5										42	320
7/16/2010	SW015	23										240	31
8/24/2010	SW015	25										22	31
9/8/2010	SW015	22.75										560	940
10/27/2010	SW015	18										180	42
11/15/2010	SW015	9.5										40	270
12/8/2010	SW015	9										20	31
1/3/2010	SW016	10										1.9	20
2/8/2010	SW016	13.5										1.9	31
3/29/2010	SW016	11										54	75
4/14/2010	SW016	19										1.9	42
5/12/2010	SW016	19										22	31
6/28/2010	SW016	17										2	20
7/16/2010	SW016	24.5										2	53
10/27/2010	SW016	13										110	410
11/15/2010	SW016	9.5										76	530
12/8/2010	SW016	9										26	20
1/3/2010	SW017	11										1.9	9
2/8/2010	SW017	14										1.9	9
3/29/2010	SW017	11										100	110
4/14/2010	SW017	15										1.9	9

Table A.1 2010 Selected Water Quality Results

Run Date	Site Number	Air Temperature (deg C)	Alkalinity (mg/l)	Ammonia (mg/l)	Arsenic (mg/l)	Biochemical Oxygen Demand (mg/l)	Chemical Oxygen Demand (mg/l)	Chlorophyll a (ug/l)	Chromium (mg/l)	Copper (mg/l)	Diesel Range Plus (mg/l)	E. coli (cfu/100ml)	Enterococcus (cfu/100ml)
5/12/2010	SW017	19										1.9	10
6/28/2010	SW017	19										98	220
7/16/2010	SW017	27										320	2000
10/27/2010	SW017	12										160	64
11/15/2010	SW017	8.5										30	320
12/8/2010	SW017	9										22	20
1/26/2010	SW019	11										2	9
2/9/2010	SW019	9										2	9
3/15/2010	SW019	12										1.9	9
4/6/2010	SW019	10.5										2.9	9
5/7/2010	SW019	16										2	9
6/8/2010	SW019	18.5										4	9
7/19/2010	SW019	20										6	10
8/17/2010	SW019	23										1.9	10
9/7/2010	SW019	18.5										28	31
10/12/2010	SW019	18										62	87
11/9/2010	SW019	7.5										10	10
1/26/2010	SW022	12										1.9	9
2/9/2010	SW022	8										1.9	9
3/15/2010	SW022	12.5										1.9	9
4/6/2010	SW022	9										1.9	10
5/7/2010	SW022	14										2	9
6/8/2010	SW022	19										1.9	9
7/19/2010	SW022	19										1.9	9
8/17/2010	SW022	22										1.9	9
9/7/2010	SW022	15.25										1.9	8
10/12/2010	SW022	15										1.9	9
11/9/2010	SW022	8										1.9	9
1/26/2010	SW023	6										1.9	9
2/9/2010	SW023	9										1.9	9
3/15/2010	SW023	11.75										1.9	9
4/6/2010	SW023	10										1.9	9
5/7/2010	SW023	15										1.9	9
6/8/2010	SW023	16										2	10
7/19/2010	SW023	25.5										2	9
8/17/2010	SW023	19.5										1.9	9
9/7/2010	SW023	15										1.9	8
10/12/2010	SW023	18										4	9
11/9/2010	SW023	11										50	160
2/9/2010	SW025	7										6	20
3/15/2010	SW025	11										18	9
4/6/2010	SW025	12										1.9	10
1/26/2010	SW026	10										1.9	9
2/9/2010	SW026	10										34	9.5

Table A.1 2010 Selected Water Quality Results

Run Date	Site Number	Air Temperature (deg C)	Alkalinity (mg/l)	Ammonia (mg/l)	Arsenic (mg/l)	Biochemical Oxygen Demand (mg/l)	Chemical Oxygen Demand (mg/l)	Chlorophyll a (ug/l)	Chromium (mg/l)	Copper (mg/l)	Diesel Range Plus (mg/l)	E. coli (cfu/100ml)	Enterococcus (cfu/100ml)
3/15/2010	SW026	16.5										55.95	9.5
4/6/2010	SW026	12										145	36.5
5/7/2010	SW026	17										360	10
6/8/2010	SW026	19.5										55	112
9/7/2010	SW026	16.5										2	160
11/9/2010	SW026	10										44	120.5
1/26/2010	SW027	4										22	10
2/9/2010	SW027	9										28	15
3/15/2010	SW027	15										5	9
4/6/2010	SW027	11.25										7.10	160
5/7/2010	SW027	12.75										18	9
6/8/2010	SW027	18.16666667										230	795
1/26/2010	SW028	8										1.9	9
2/9/2010	SW028	14										8	10
3/15/2010	SW028	16.33333333										12.5	7.5
4/6/2010	SW028	10.5										24	20
5/7/2010	SW028	16										52	10
6/8/2010	SW028	17										74	9.5
7/19/2010	SW028	24										22	9
8/17/2010	SW028	24										500	31
9/7/2010	SW028	17										40	20
10/12/2010	SW028	19										170	160
11/9/2010	SW028	9.5										67	136
1/27/2010	SW029	2										12	9
2/17/2010	SW029	9										1.9	9
3/24/2010	SW029	16										2	9
4/28/2010	SW029	11.5										320	20
5/26/2010	SW029	13										600	42
6/29/2010	SW029	16										140	220
10/13/2010	SW029	13										8	10
11/10/2010	SW029	17										20	9
1/27/2010	SW030	10										1.9	10
2/17/2010	SW030	15										1.9	9
3/24/2010	SW030	17										2	9
4/28/2010	SW030	15.75										68	9
5/26/2010	SW030	13.5										1.9	9
6/29/2010	SW030	19.75										10	9
7/20/2010	SW030	24										8	31
8/31/2010	SW030	14										40	240
9/14/2010	SW030	23										2	10
10/13/2010	SW030	16										8	20
11/10/2010	SW030	15										1.9	9
1/27/2010	SW031	10										8	9
2/17/2010	SW031	15.5										16	9

Table A.1 2010 Selected Water Quality Results

Run Date	Site Number	Air Temperature (deg C)	Alkalinity (mg/l)	Ammonia (mg/l)	Arsenic (mg/l)	Biochemical Oxygen Demand (mg/l)	Chemical Oxygen Demand (mg/l)	Chlorophyll a (ug/l)	Chromium (mg/l)	Copper (mg/l)	Diesel Range Plus (mg/l)	E. coli (cfu/100ml)	Enterococcus (cfu/100ml)
3/24/2010	SW031	20										6	9
4/28/2010	SW031	17										1.9	10
6/29/2010	SW031	25										4	10
1/27/2010	SW032	10										1.9	9
2/17/2010	SW032	10.5										1.9	9
3/24/2010	SW032	17										1.9	9
4/28/2010	SW032	17										2	9
5/26/2010	SW032	13.75										1.9	9
6/29/2010	SW032	23										2	9
7/20/2010	SW032	24										4	9
8/31/2010	SW032	14										4	110
9/14/2010	SW032	21										14	53
10/13/2010	SW032	15										4	9
11/10/2010	SW032	10										2	20
1/27/2010	SW033	8.5										12	9
2/17/2010	SW033	15										8	9
3/24/2010	SW033	16										14	9
4/28/2010	SW033	15.5										18	9
6/29/2010	SW033	19										48	31
1/27/2010	SW034	8.5										1.9	8.9
2/17/2010	SW034	15										2	9
3/24/2010	SW034	19										2	9
4/28/2010	SW034	15.5										4	9
5/26/2010	SW034	13										1.9	9
6/29/2010	SW034	19										6	10
7/20/2010	SW034	27										2	9
8/31/2010	SW034	14										2	20
9/14/2010	SW034	19										18	75
10/13/2010	SW034	15										8	9
11/10/2010	SW034	11.5										30	42
1/27/2010	SW035	9.5										6	9
2/17/2010	SW035	12										34	10
4/28/2010	SW035	14										14	9
1/27/2010	SW036	9.5										1.9	9
2/17/2010	SW036	12										6	9
3/24/2010	SW036	15										2	9
4/28/2010	SW036	14										1.9	9
5/26/2010	SW036	14										2	9
6/29/2010	SW036	18										8	9
7/20/2010	SW036	23										1.9	9
8/31/2010	SW036	13.5										4	42
9/14/2010	SW036	19										6	10
10/13/2010	SW036	15										14	10
11/10/2010	SW036	17										4	20

Table A.1 2010 Selected Water Quality Results

Run Date	Site Number	Air Temperature (deg C)	Alkalinity (mg/l)	Ammonia (mg/l)	Arsenic (mg/l)	Biochemical Oxygen Demand (mg/l)	Chemical Oxygen Demand (mg/l)	Chlorophyll a (ug/l)	Chromium (mg/l)	Copper (mg/l)	Diesel Range Plus (mg/l)	E. coli (cfu/100ml)	Enterococcus (cfu/100ml)
2/17/2010	SW037	13										1.9	9
3/24/2010	SW037	21										2	9
1/27/2010	SW038	8										2	9
2/17/2010	SW038	12										14	9
3/24/2010	SW038	21										2	10
4/28/2010	SW038											1.9	9
5/26/2010	SW038	14.5										1.9	9
6/29/2010	SW038	20										1.9	9
7/20/2010	SW038	26										1.9	9
8/31/2010	SW038	14										4	10
9/14/2010	SW038	18										4	31
10/13/2010	SW038	17										8	10
11/10/2010	SW038	10										10	10
1/27/2010	SW039	8										1.9	9
2/17/2010	SW039	10.5										1.9	9
3/24/2010	SW039	11										2	9
4/28/2010	SW039	16.5										4	9
5/26/2010	SW039	15.5										4	10
6/29/2010	SW039	19										14	19
7/20/2010	SW039											6	9
8/31/2010	SW039											34	87
9/14/2010	SW039	17										1.9	20
10/13/2010	SW039	17										26	75
11/10/2010	SW039	12.5										26	2000
1/13/2010	SW051	8										66	240
1/14/2010	SW051	9										16	31
2/18/2010	SW051	9										1.9	10
2/16/2010	SW051	9										20	10
3/10/2010	SW051	7										1.9	120
3/29/2010	SW051	9.5										50	53
4/14/2010	SW051	14										1.9	9
4/27/2010	SW051											8	10
5/12/2010	SW051	14										2	9
5/25/2010	SW051	16										2	9
6/22/2010	SW051	17										2	9
6/28/2010	SW051	16										18	42
7/16/2010	SW051	19										660	10
7/29/2010	SW051	17										2	20
8/24/2010	SW051	21										48	250
8/25/2010	SW051	20										12	9
9/8/2010	SW051	19										6	9
9/9/2010	SW051	18										28	64
10/26/2010	SW051	9										40	240
10/27/2010	SW051	15.5										80	620
11/15/2010	SW051	8.5										58	1400
11/23/2010	SW051	9										10	9
12/18/2010	SW051											96	53
1/13/2010	SW052	10.5										1.9	9

Table A.1 2010 Selected Water Quality Results

Run Date	Site Number	Air Temperature (deg C)	Alkalinity (mg/l)	Ammonia (mg/l)	Arsenic (mg/l)	Biochemical Oxygen Demand (mg/l)	Chemical Oxygen Demand (mg/l)	Chlorophyll a (ug/l)	Chromium (mg/l)	Copper (mg/l)	Diesel Range Plus (mg/l)	E. coli (cfu/100ml)	Enterococcus (cfu/100ml)
2/8/2010	SW052	11										1.9	9
3/29/2010	SW052	11.5										1.9	9
4/14/2010	SW052	17										1.9	9
5/12/2010	SW052	14										1.9	9
6/28/2010	SW052	16.5										1.9	9
7/16/2010	SW052	22.5										1.9	9
8/24/2010	SW052	25										1.9	9
9/8/2010	SW052	20										1.9	9
10/27/2010	SW052	13										28	64
11/15/2010	SW052	9										6	9
12/8/2010	SW052	11										6	9
1/14/2010	SW053	8										4	10
2/16/2010	SW053	10.5										400	620
3/10/2010	SW053	8.5										1.9	9
4/27/2010	SW053	18.5										40	31
5/25/2010	SW053	18										58	10
6/22/2010	SW053	17										62	120
7/29/2010	SW053	21.25										4	9
8/25/2010	SW053	22										10	10
9/9/2010	SW053	22.75										12	9
10/28/2010	SW053	9										58	110
11/23/2010	SW053											48	42
1/13/2010	SW055	10.5										14	31
2/8/2010	SW055	12										4	9
3/29/2010	SW055	11										1.9	9
4/14/2010	SW055	16										1.9	9
5/12/2010	SW055	13										2	10
6/28/2010	SW055	16										1.9	9
7/16/2010	SW055	19										1.9	9
8/24/2010	SW055	24										170	20
9/8/2010	SW055	22										1.9	9
10/27/2010	SW055	19										1.9	9
11/15/2010	SW055	10										50	87
12/8/2010	SW055	10										14	10
1/13/2010	SW056	11										14	9
2/8/2010	SW056	13										42	9
3/29/2010	SW056	11										40	31
4/14/2010	SW056	16.5										12	10
5/12/2010	SW056	21										36	31
6/28/2010	SW056	17										64	75
7/16/2010	SW056	26										2	10
8/24/2010	SW056	24										14	20
9/8/2010	SW056	22.5										46	20
10/27/2010	SW056	15										260	20
11/15/2010	SW056	9										120	53
12/8/2010	SW056	11										128	20

Table A.1 2010 Selected Water Quality Results

Run Date	Site Number	Air Temperature (deg C)	Alkalinity (mg/l)	Ammonia (mg/l)	Arsenic (mg/l)	Biochemical Oxygen Demand (mg/l)	Chemical Oxygen Demand (mg/l)	Chlorophyll a (ug/l)	Chromium (mg/l)	Copper (mg/l)	Diesel Range Plus (mg/l)	E. coli (cfu/100ml)	Enterococcus (cfu/100ml)
1/14/2010	SW058	8										30	42
2/16/2010	SW058	11										8	270
3/10/2010	SW058	7.5										1.9	20
10/26/2010	SW058	10										160	110
11/23/2010	SW058											1.9	20
1/13/2010	SW059	11										26	9
2/8/2010	SW059	14.5										14	10
3/29/2010	SW059	11.25										130	31
4/14/2010	SW059	16										1.9	20
5/12/2010	SW059	17.25										1.9	10
6/28/2010	SW059	19										24	270
7/16/2010	SW059	21										240	10
8/24/2010	SW059	20.5										440	310
9/8/2010	SW059	17.5										92	31
10/27/2010	SW059	14										34	10
11/15/2010	SW059	8.5										20	31
12/8/2010	SW059	9.75										8	10
1/13/2010	SW072	12										230	53
2/8/2010	SW072	10.5										1.9	9
3/29/2010	SW072	12										2	10
4/14/2010	SW072	16										1.9	9
5/12/2010	SW072	15										22	9
6/28/2010	SW072	18										72	99
7/16/2010	SW072	21										82	53
8/24/2010	SW072	21										32	9
9/8/2010	SW072	19										80	31
10/27/2010	SW072	13										14	9
11/15/2010	SW072	9										6	9
12/8/2010	SW072	9										12	9
1/27/2010	SW118	9.5										22	10
2/8/2010	SW118	13										14	10
2/16/2010	SW118	12										40	64
2/17/2010	SW118	11										38	10
3/10/2010	SW118	9										8.9	10
3/24/2010	SW118	16.5										8	9
3/29/2010	SW118	11										82	31
4/14/2010	SW118	15										16	9
4/27/2010	SW118	15										4	9
4/28/2010	SW118	13										18	9
5/12/2010	SW118	15										8	9
5/25/2010	SW118	21										10	10
5/26/2010	SW118	13										14	31
6/22/2010	SW118	23										8	9
6/28/2010	SW118	17										46	42
6/29/2010	SW118	17										26	20
7/16/2010	SW118	24										20	9
7/20/2010	SW118	24										10	9
7/29/2010	SW118	19										10	10
8/24/2010	SW118	23										14	9

Table A.1 2010 Selected Water Quality Results

Run Date	Site Number	Air Temperature (deg C)	Alkalinity (mg/l)	Ammonia (mg/l)	Arsenic (mg/l)	Biochemical Oxygen Demand (mg/l)	Chemical Oxygen Demand (mg/l)	Chlorophyll a (ug/l)	Chromium (mg/l)	Copper (mg/l)	Diesel Range Plus (mg/l)	E. coli (cfu/100ml)	Enterococcus (cfu/100ml)
8/25/2010	SW118	25										80	42
8/31/2010	SW118											66	42
9/6/2010	SW118	19										42	64
9/9/2010	SW118	16										36	10
9/14/2010	SW118	21										86	220
10/13/2010	SW118	13										26	20
10/26/2010	SW118	9										680	950
10/27/2010	SW118	13										86	110
11/10/2010	SW118	9										8	9
11/15/2010	SW118	9										18	20
11/23/2010	SW118											1.9	10
12/8/2010	SW118	9										12	20

Table A.2 2010 Selected Water Quality Results

Run Date	Site Number	Fecal Coliform (cfu/100ml)	Flow - Direction	Flow (cfs)	Hardness (mg/l)	Iron (mg/l)	Lead (mg/l)	Lube Oil Range Hydrocarbons (mg/l)	Mercury (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Orthophosphate (mg/l)	Oxygen Saturation (%)
1/25/2010	DH038	2	2										100.7
3/3/2010	DH038	1.7	6										96.45
5/13/2010	DH038	1.7	2										140.9
7/12/2010	DH038	1.7	2										110.3
9/27/2010	DH038	2	2										91.85
1/8/2010	DH038	1.7	6										89.65
12/14/2010	DH038	23	9										98.2
1/25/2010	DH039	4	2										103.1
3/3/2010	DH039	2	6										92.8
5/13/2010	DH039	1.7	8										123.2
7/12/2010	DH039	1.7	3										105.8
9/27/2010	DH039	1.7	2										90
11/8/2010	DH039	1.7	2										89.5
12/14/2010	DH039	2	2										96.6
1/25/2010	DH040	7.8	2										99.6
3/3/2010	DH040	1.7	6										87.1
5/13/2010	DH040	1.7	2										120.1
7/12/2010	DH040	1.7	3										107.4
9/27/2010	DH040	2	2										92.6
11/8/2010	DH040	4.5	6										89.8
12/14/2010	DH040	17	2										95.9
1/25/2010	DH041	7.8	2										96.5
3/3/2010	DH041	1.7	6										85.9
5/13/2010	DH041	1.7	9										123.2
7/12/2010	DH041	2	3										116.3
9/27/2010	DH041	4	2										102
11/8/2010	DH041	4.5	6										91
1/25/2010	DH042	3	3										97.9
3/3/2010	DH042	1.7	6										98.5
5/13/2010	DH042	1.7	2										190.2
7/12/2010	DH042	1.7	3										125.4
9/27/2010	DH042	1.7	2										93.5
11/8/2010	DH042	7.8	6										91.4
1/25/2010	DH043	4.5	2										102.1
3/3/2010	DH043	4.5	6										94.2
5/13/2010	DH043	1.7	3										151.3
7/12/2010	DH043	1.7	3										102.8
9/27/2010	DH043	1.7	2										106.1
11/8/2010	DH043	1.7	6										91.3
1/25/2010	DH044	2	8										120.3
3/3/2010	DH044	2	4										102.7
5/13/2010	DH044	1.7	1										116.1
7/12/2010	DH044	1.7	1	0									99.5
9/27/2010	DH044	1.7	4										102.8

Table A.2 2010 Selected Water Quality Results

Run Date	Site Number	Fecal Coliform (cfu/100ml)	Flow - Direction (None)	Flow (cfs)	Hardness (mg/l)	Iron (mg/l)	Lead (mg/l)	Lube Oil Range Hydrocarbons (mg/l)	Mercury (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Orthophosphate (mg/l)	Oxygen Saturation (%)
12/14/2010	DH044	2	1										101.1
1/25/2010	DH045	4	8										135.4
3/3/2010	DH045	1.7	4										137.95
5/13/2010	DH045	1.7	1	0									134.3
7/12/2010	DH045	1.7	9										84.9
9/27/2010	DH045	1.7	8										122.1
11/18/2010	DH045	1.7	8										142
12/14/2010	DH045	1.7	8										107.7
1/27/2010	DH048	1.7											
3/24/2010	DH048	1.7											
5/26/2010	DH048	1.7											
7/20/2010	DH048	1.7											
9/14/2010	DH048	1.7											
11/16/2010	DH048	1.7											
1/27/2010	DH049	1.7											
3/24/2010	DH049	1.7											
5/26/2010	DH049	2											
7/20/2010	DH049	1.7											
9/14/2010	DH049	49											
11/16/2010	DH049	33											
12/14/2010	DH049	14	9										102.5
1/27/2010	DH050	1.7											
3/24/2010	DH050	1.7											
5/26/2010	DH050	1.7											
7/20/2010	DH050	1.7											
9/14/2010	DH050	23											
11/16/2010	DH050	33											
1/27/2010	DH051	2											
3/24/2010	DH051	13											
5/26/2010	DH051	1.7											
7/20/2010	DH051	1.7											
9/14/2010	DH051	7.8											
11/16/2010	DH051	79											
1/27/2010	DH052	2											
3/24/2010	DH052	13											
5/26/2010	DH052	2											
7/20/2010	DH052	1.7											
9/14/2010	DH052	49											
11/16/2010	DH052	14											
12/14/2010	DH052	49	3										104.3
1/27/2010	DH053	1.7											
3/24/2010	DH053	1.7											
5/26/2010	DH053	2											
7/20/2010	DH053	1.7											

Table A.2 2010 Selected Water Quality Results

Run Date	Site Number	Fecal Coliform (cfu/100ml)	Flow - Direction (None)	Flow (cfs)	Hardness (mg/l)	Iron (mg/l)	Lead (mg/l)	Lube Oil Range Hydrocarbons (mg/l)	Mercury (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Orthophosphate (mg/l)	Oxygen Saturation (%)
9/14/2010	DH053	6.8											
11/16/2010	DH053	49											
1/27/2010	DH054	1.7											
3/24/2010	DH054	2											
5/26/2010	DH054	1.7											
7/20/2010	DH054	2											
9/14/2010	DH054	13											
11/16/2010	DH054	170											
1/27/2010	DH055	1.7											
3/24/2010	DH055	21											
5/26/2010	DH055	4.5											
7/20/2010	DH055	1.7											
9/14/2010	DH055	33											
11/16/2010	DH055	33											
1/27/2010	DH057	2											
3/24/2010	DH057	79											
5/26/2010	DH057	1.7											
7/20/2010	DH057	1.7											
9/14/2010	DH057	240											
11/16/2010	DH057	23											
12/14/2010	DH057	17	4										101.7
1/27/2010	DH058	1.7											
3/24/2010	DH058	1.7											
5/26/2010	DH058	1.7											
7/20/2010	DH058	1.7											
9/14/2010	DH058	49											
11/16/2010	DH058	33											
1/27/2010	DH271	1.7											
3/24/2010	DH271	13											
5/26/2010	DH271	1.7											
7/20/2010	DH271	1.7											
9/14/2010	DH271	33											
12/14/2010	DH271	33	2										104.4
3/24/2010	DH272	7.8											
5/26/2010	DH272	1.7											
7/20/2010	DH272	1.7											
9/14/2010	DH272	33											
11/16/2010	DH272	79											
1/25/2010	DH285	7.8	2										105.1
3/3/2010	DH285	1.7	5										103.4
5/13/2010	DH285	1.7	2										133.2
7/12/2010	DH285	2	2										102.6
9/27/2010	DH285	1.7	2										97.7

Table A.2 2010 Selected Water Quality Results

Run Date	Site Number	Fecal Coliform (cfu/100ml)	Flow - Direction (None)	Flow (cfs)	Hardness (mg/l)	Iron (mg/l)	Lead (mg/l)	Lube Oil Range Hydrocarbons (mg/l)	Mercury (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Orthophosphate (mg/l)	Oxygen Saturation (%)
11/8/2010	DH285	17											97.6
12/14/2010	DH285	23	9										100.3
1/25/2010	DH286	4	3										103.6
3/3/2010	DH286	1.7	8										97.3
5/13/2010	DH286	1.7	6										153.7
7/12/2010	DH286	1.7	2										122
9/27/2010	DH286	6.8	2										68.9
11/8/2010	DH286	7.8	2										98.5
12/14/2010	DH286	33	9										103.3
1/25/2010	DH287	4.5	9										103.3
3/3/2010	DH287	1.7	6										102.3
5/13/2010	DH287	1.7	2										124.3
7/12/2010	DH287	1.7	2										102.4
9/27/2010	DH287	2	2										87.5
11/8/2010	DH287	1.7	2										90.3
12/14/2010	DH287	4	9										89.2
1/25/2010	DH288	6.1	2										102.1
3/3/2010	DH288	2	9										97.1
5/13/2010	DH288	1.7	9										136.2
7/12/2010	DH288	2	2										116.3
9/27/2010	DH288	1.7	2										91.6
11/8/2010	DH288	1.7	2										91.7
12/14/2010	DH288	13	9										101.9
1/26/2010	SW001	1.9	11		5190			0.45	0.00045				95.6
2/9/2010	SW001	1.9	11										86.7
3/15/2010	SW001	1.9	11										98.4
4/16/2010	SW001	1.9	11										112.8
5/7/2010	SW001	1.9	10										109.05
6/8/2010	SW001	1.9	11										126.6
7/19/2010	SW001	4	8										128.8
8/17/2010	SW001	6	3										109.5
9/7/2010	SW001	2	11										80.6
10/12/2010	SW001	6	11										85.7
11/9/2010	SW001	10	10										106.7
1/26/2010	SW002	1.9	6			0.15				0.27	0.09	0.06	97.4
2/9/2010	SW002	1.9	6										88.8
3/15/2010	SW002	1.9	6										111.3
4/16/2010	SW002	1.9	7										123.6
5/7/2010	SW002	1.9	8										132.9
6/8/2010	SW002	1.9	8										191.6
7/19/2010	SW002	1.9	8										132.5
8/17/2010	SW002	1.9	1										139.2
9/7/2010	SW002	2	3										100
10/12/2010	SW002	1.9	7										87.65

Table A.2 2010 Selected Water Quality Results

Run Date	Site Number	Fecal Coliform (cfu/100ml)	Flow - Direction (None)	Flow (cfs)	Hardness (mg/l)	Iron (mg/l)	Lead (mg/l)	Lube Oil Range Hydrocarbons (mg/l)	Mercury (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Orthophosphate (mg/l)	Oxygen Saturation (%)
1/9/2010	SW002	2	3										112
1/14/2010	SW003	26	11			2.4				0.37	0.045	0.036	64.1
2/16/2010	SW003	720	11										89.6
3/10/2010	SW003	6	1	0									76.3
4/27/2010	SW003	42	11										71.8
5/25/2010	SW003	58	11										61.2
6/22/2010	SW003	76	11										27.3
7/29/2010	SW003	360	11	0									90.3
8/25/2010	SW003	12	1	0									71.6
9/9/2010	SW003	2	1	0									51
10/28/2010	SW003	54	11										34.3
11/23/2010	SW003	66	11										30.1
1/13/2010	SW004	26	11										103
1/14/2010	SW004	40	11										105.3
1/26/2010	SW006	1.9	1			0.25				0.54	0.09	0.07	97.4
2/9/2010	SW006	2	9										96.6
3/15/2010	SW006	2	4										103.4
4/6/2010	SW006	1.9	3										117.1
5/7/2010	SW006	2	4										110.7
6/8/2010	SW006	2	4										147.1
7/19/2010	SW006	1.9	4										115.4
8/17/2010	SW006	1.9	6										156.65
9/7/2010	SW006	1.9	9										115.2
10/12/2010	SW006	38	2										102.4
11/9/2010	SW006	8	4										118.9
1/27/2010	SW007	10	11										100.1
2/17/2010	SW007	46	11										105.35
3/24/2010	SW007	20	11										109.4
4/28/2010	SW007	26	11										103.1
5/26/2010	SW007	42	11										100.8
6/29/2010	SW007	28	11										111.15
7/20/2010	SW007	28	11										111.1
8/31/2010	SW007	130	11										76.7
9/14/2010	SW007	110	11										99.9
10/13/2010	SW007	28	11										101.45
11/10/2010	SW007	8	11										107.2
1/14/2010	SW008	58	11										82.3
2/16/2010	SW008	160	11										73.9
3/10/2010	SW008	14	11										80.1
4/27/2010	SW008	600	10										65.8
5/25/2010	SW008	88	10										53
6/22/2010	SW008	380	10										58.3
7/29/2010	SW008	2	10										40.9
8/25/2010	SW008	12	12										31.9

Table A.2 2010 Selected Water Quality Results

Run Date	Site Number	Fecal Coliform (cfu/100ml)	Flow - Direction (None)	Flow (cfs)	Hardness (mg/l)	Iron (mg/l)	Lead (mg/l)	Lube Oil Range Hydrocarbons (mg/l)	Mercury (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Orthophosphate (mg/l)	Oxygen Saturation (%)
9/9/2010	SW008	360	10										37.2
10/26/2010	SW008	62	11										90.4
1/14/2010	SW009	22				2.5				0.48	0.045	0.045	81.1
2/16/2010	SW009	140	1										91
3/10/2010	SW009	20	1	0									108.4
4/27/2010	SW009	160	1										143.6
5/25/2010	SW009	500	1	0									42.4
6/22/2010	SW009	260	1	0									42.1
7/29/2010	SW009	200	1	0									76.6
8/25/2010	SW009	74	1	0									220.6
9/9/2010	SW009	2100	1	0									64
10/26/2010	SW009	500	11										46.3
1/14/2010	SW010	36	11										59.3
2/16/2010	SW010	48	1										59.3
3/10/2010	SW010	26	1	0									58.5
5/25/2010	SW010	72	11										69.8
6/22/2010	SW010	120	11										51.7
7/29/2010	SW010	6	1	0									170.5
8/25/2010	SW010	100	1	0									3.9
9/9/2010	SW010	1000	1	0									34.5
10/26/2010	SW010	8	1	0									23
1/14/2010	SW011	88	11										103.4
2/16/2010	SW011	420	11										103.8
3/10/2010	SW011	52	11										106.6
4/27/2010	SW011	220	11										104.3
5/25/2010	SW011	520	11										101.4
6/22/2010	SW011	1200	11										105.1
7/29/2010	SW011	10	1	0									104.7
8/25/2010	SW011	2400	1	0									76.95
9/9/2010	SW011	1700	11										77.8
10/26/2010	SW011	620	11										94.5
11/23/2010	SW011	56	11										55.1
1/14/2010	SW012	16	11										59.85
2/16/2010	SW012	32	11										81.1
3/10/2010	SW012	62	11										81
4/27/2010	SW012	60	11										46
5/25/2010	SW012	340	11										47.6
6/22/2010	SW012	280	11										42.4
7/29/2010	SW012	36	1	0									248.6
8/25/2010	SW012	60	1	0									132.5
9/9/2010	SW012	200	1	0									112.6
10/26/2010	SW012	78	11										50.6
11/23/2010	SW012	22	1	0									81.7
1/14/2010	SW013	1.9	1	0									66.6

Table A.2 2010 Selected Water Quality Results

Run Date	Site Number	Fecal Coliform (cfu/100ml)	Flow - Direction (None)	Flow (cfs)	Hardness (mg/l)	Iron (mg/l)	Lead (mg/l)	Lube Oil Range Hydrocarbons (mg/l)	Mercury (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Orthophosphate (mg/l)	Oxygen Saturation (%)
2/16/2010	SW013	90	11										68.6
3/10/2010	SW013	12	1	0									29.4
4/27/2010	SW013	32	1										49.7
5/25/2010	SW013	22	1	0									148.3
6/22/2010	SW013	44	1	0									32.1
7/29/2010	SW013	120	1	0									221.1
8/25/2010	SW013	50	1	0									372
9/9/2010	SW013	13	1	0									373.3
10/26/2010	SW013	98	1	0									37.5
1/14/2010	SW014	34	11		51		0.0009	0.45					75.3
2/16/2010	SW014	66	11										91.5
3/10/2010	SW014	22	11										83
4/27/2010	SW014	280	1	0									79.5
5/25/2010	SW014	800	1	0									78.35
6/22/2010	SW014	56	1	0									78.1
9/9/2010	SW014	64	1	0									43.3
10/26/2010	SW014	66	11										76.95
11/23/2010	SW014	92	1	0									45.1
1/13/2010	SW015	30	1	0		6.6			0.045	0.045		0.045	41.3
2/8/2010	SW015	6	11										43.6
3/29/2010	SW015	800	1										72.5
4/14/2010	SW015	8	1										60.2
5/12/2010	SW015	6	1	0		2.4				0.045		0.45	97
6/28/2010	SW015	42	1	0									36.5
7/16/2010	SW015	240	1	0									49.6
8/24/2010	SW015	22	1	0									91.6
9/8/2010	SW015	560	1	0									35.15
10/27/2010	SW015	180	1	0									46.4
11/15/2010	SW015	40	11										64.6
12/8/2010	SW015	20	1	0									80.3
1/13/2010	SW016	1.9	11										38.4
2/8/2010	SW016	2	11										27.1
3/29/2010	SW016	54	11										83.8
4/14/2010	SW016	1.9	11										49.5
5/12/2010	SW016	22	1	0									23.3
6/28/2010	SW016	2	1	0									13.1
7/16/2010	SW016	2	1	0									96.6
10/27/2010	SW016	110	1	0									27.4
11/15/2010	SW016	76	11										46.1
12/8/2010	SW016	26	11										57.5
1/13/2010	SW017	1.9	11										74.4
2/8/2010	SW017	16	1	0									35.8
3/29/2010	SW017	100	1										81.2
4/14/2010	SW017	1.9	1										27.3

Table A.2 2010 Selected Water Quality Results

Run Date	Site Number	Fecal Coliform (cfu/100ml)	Flow - Direction (None)	Flow (cfs)	Hardness (mg/l)	Iron (mg/l)	Lead (mg/l)	Lube Oil Range Hydrocarbons (mg/l)	Mercury (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Orthophosphate (mg/l)	Oxygen Saturation (%)
5/12/2010	SW017	2	1	0									39.8
6/28/2010	SW017	98	1	0									27.1
7/16/2010	SW017	320	1	0									8.7
10/27/2010	SW017	160	1	0									34.4
11/15/2010	SW017	30	1	0									11.8
12/8/2010	SW017	22	11										74.8
1/26/2010	SW019	2	3										92
2/9/2010	SW019	2	9										89.2
3/15/2010	SW019	1.9	2										95.4
4/6/2010	SW019	1.9	9										111.8
5/7/2010	SW019	2	7										109.2
6/8/2010	SW019	4	3										125.9
7/19/2010	SW019	6	4										128.3
8/17/2010	SW019	1.9	6										112.3
9/7/2010	SW019	28	2										87
10/12/2010	SW019	62	2										87.1
11/9/2010	SW019	10	4										101.5
1/26/2010	SW022	1.9	6										94.8
2/9/2010	SW022	1.9	7										99
3/15/2010	SW022	1.9	8										114.4
4/6/2010	SW022	1.9	7										121.6
5/7/2010	SW022	2	8										117
6/8/2010	SW022	1.9	8										152.2
7/19/2010	SW022	1.9	3										130.2
8/17/2010	SW022	1.9	4										123.3
9/7/2010	SW022	1.9	3										84.2
10/12/2010	SW022	1.9	6										87.8
11/9/2010	SW022	1.9	9										109.6
1/26/2010	SW023	2	3										98.7
2/9/2010	SW023	1.9	8										99.2
3/15/2010	SW023	1.9	4										102.5
4/6/2010	SW023	1.9	2										113.15
5/7/2010	SW023	2	4										103.6
6/8/2010	SW023	2	2										146
7/19/2010	SW023	1.9	8										112.7
8/17/2010	SW023	1.9	2										150.8
9/7/2010	SW023	6	9										114.4
10/12/2010	SW023	54	2										103.9
11/9/2010	SW023	6	5										124.1
2/9/2010	SW025	6	11										94.4
3/15/2010	SW025	18	11										90.2
4/6/2010	SW025	56	11										80.6
1/26/2010	SW026	1.9	11										94.4
2/9/2010	SW026	34	7.5										108.05

Table A.2 2010 Selected Water Quality Results

Run Date	Site Number	Fecal Coliform (ctf/100ml)	Flow - Direction (None)	Flow (cfs)	Hardness (mg/l)	Iron (mg/l)	Lead (mg/l)	Lube Oil Range Hydrocarbons (mg/l)	Mercury (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Orthophosphate (mg/l)	Oxygen Saturation (%)
3/15/2010	SW026	55.95	8.5										127.15
4/6/2010	SW026	145	6.5										138.75
5/7/2010	SW026	360	11										
6/8/2010	SW026	55	2.5	0									113.6
9/7/2010	SW026	2	1	0									88.5
11/9/2010	SW026	44	7.5										128.65
1/26/2010	SW027	22	10										96.7
2/9/2010	SW027	28	8										96.83333333
3/15/2010	SW027	5	9										112.95
4/6/2010	SW027	710	7										118.65
5/7/2010	SW027	18	11										102.7
6/8/2010	SW027	230	7.5										106.7666667
1/26/2010	SW028	1.9	10										105.4
2/9/2010	SW028	8	7										142.25
3/15/2010	SW028	11	7.5										131.5333333
4/6/2010	SW028	24	7										113.65
5/7/2010	SW028	52	11										104.1
6/8/2010	SW028	74	2.5										146.5
7/19/2010	SW028	22	1	0									92.2
8/17/2010	SW028	500	1	0									103.1
9/7/2010	SW028	40	1	0									120.3
10/12/2010	SW028	170	8.5										114.45
11/9/2010	SW028	67	7.5										127.75
1/27/2010	SW029	12	11										105.3
2/17/2010	SW029	2	11										102.5
3/24/2010	SW029	2	11										101
4/28/2010	SW029	320	11										97.2
5/26/2010	SW029	600	11										96.3
6/29/2010	SW029	140	11										103.3
10/13/2010	SW029	8	11										68.7
11/10/2010	SW029	20	11										91.5
1/27/2010	SW030	1.9	2										103.8
2/17/2010	SW030	1.9	2										122
3/24/2010	SW030	2	3										126.6
4/28/2010	SW030	68	2										98.2
5/28/2010	SW030	1.9	3										142.9
6/29/2010	SW030	10	2										105.7
7/20/2010	SW030	8	9										121.3
8/31/2010	SW030	40	2										106.4
9/14/2010	SW030	2	4										108.1
10/13/2010	SW030	8	3										105.6
11/10/2010	SW030	1.9	2										104.6
1/27/2010	SW031	8	11										75.2
2/17/2010	SW031	16	11										87.1

Table A.2 2010 Selected Water Quality Results

Run Date	Site Number	Fecal Coliform (cfu/100ml)	Flow - Direction (None)	Flow (cfs)	Hardness (mg/l)	Iron (mg/l)	Lead (mg/l)	Lube Oil Range Hydrocarbons (mg/l)	Mercury (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Orthophosphate (mg/l)	Oxygen Saturation (%)
3/24/2010	SW031	6	11										99.2
4/28/2010	SW031	1.9	11										76.4
6/29/2010	SW031	4	11										51.7
1/27/2010	SW032	1.9	2										103.7
2/17/2010	SW032	1.9	5										112.5
3/24/2010	SW032	1.9	4										149.9
4/28/2010	SW032	2	7										119.5
5/26/2010	SW032	1.9	8										147.85
6/29/2010	SW032	2	9										193.3
7/20/2010	SW032	4	8										119.7
8/31/2010	SW032	4	8										103.9
9/14/2010	SW032	14	3										105.6
10/13/2010	SW032	4	2										100
11/10/2010	SW032	2	1										102.1
1/27/2010	SW033	12	11										62.8
2/17/2010	SW033	8	11										78.1
3/24/2010	SW033	14	11										87.1
4/28/2010	SW033	18	11										78.5
6/29/2010	SW033	48	11										56.2
1/27/2010	SW034	1.9	8										104.2
2/17/2010	SW034	2	8										113.1
3/24/2010	SW034	2	3										144.7
4/28/2010	SW034	4	3										121.5
5/26/2010	SW034	1.9	9										160.8
6/29/2010	SW034	6	9										186.1
7/20/2010	SW034	2	3										129.4
8/31/2010	SW034	2	9										107.3
9/14/2010	SW034	18	3										104.2
10/13/2010	SW034	8	2										103.7
11/10/2010	SW034	30	1										105.2
1/27/2010	SW035	6	1	0									67.1
2/17/2010	SW035	34	11										84.4
4/28/2010	SW035	14	11										81.4
1/27/2010	SW036	1.9	8										105.6
2/17/2010	SW036	6	8										100.7
3/24/2010	SW036	2	2										126.6
4/28/2010	SW036	1.9	3										106.7
5/26/2010	SW036	2	9										136.7
6/29/2010	SW036	8	9										142.2
7/20/2010	SW036	1.9	8										127.6
8/31/2010	SW036	4	2										105.8
9/14/2010	SW036	6	3										79.7
10/13/2010	SW036	14	2										99.2
11/10/2010	SW036	4	1										104.9

Table A.2 2010 Selected Water Quality Results

Run Date	Site Number	Fecal Coliform (cfu/100ml)	Flow - Direction (None)	Flow (cfs)	Hardness (mg/l)	Iron (mg/l)	Lead (mg/l)	Lube Oil Range Hydrocarbons (mg/l)	Mercury (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Orthophosphate (mg/l)	Oxygen Saturation (%)
2/17/2010	SW037	2	11										76.8
3/24/2010	SW037	2	11										76.7
1/27/2010	SW038	8											105.4
2/17/2010	SW038	14	8										98.2
3/24/2010	SW038	2	2										112.7
4/28/2010	SW038	1.9	3										189.9
5/26/2010	SW038	1.9	9										166.3
6/29/2010	SW038	1.9											123.7
7/20/2010	SW038	1.9	8										130.8
8/31/2010	SW038	4	2										103.4
9/14/2010	SW038	4	3										80.4
10/13/2010	SW038	8	3										98.3
11/10/2010	SW038	10	1										103.6
1/27/2010	SW039	1.9	0										94.7
2/17/2010	SW039	1.9	2										109.3
3/24/2010	SW039	2	1										111.4
4/28/2010	SW039	4	2										205
5/26/2010	SW039	4	6										128.1
6/29/2010	SW039	14											149.6
7/20/2010	SW039	6	4										205.9
8/31/2010	SW039	34	3										100.8
9/14/2010	SW039	1.9	4										88.2
10/13/2010	SW039	26	4										88.5
11/10/2010	SW039	26	6										96.5
1/13/2010	SW051	66	11										89.5
1/14/2010	SW051	16											100.7
2/16/2010	SW051	8	1		0								98.3
3/10/2010	SW051	20	11										90.4
3/29/2010	SW051	4											106.8
4/14/2010	SW051	50											95.4
4/14/2010	SW051	1.9											105.9
4/27/2010	SW051	8	10										110.5
5/12/2010	SW051	2											110.5
5/25/2010	SW051	2	1	0									101.6
6/22/2010	SW051	2	1	0									130.4
6/28/2010	SW051	18	1	0									73
7/16/2010	SW051	820											89.1
7/29/2010	SW051	2											76.9
8/24/2010	SW051	48											88.4
8/25/2010	SW051	12											78.5
9/8/2010	SW051	6	10										104.1
9/9/2010	SW051	28	10										84.7
10/26/2010	SW051	40											97.3
10/27/2010	SW051	92	11										89.1
11/15/2010	SW051	58											102.9
11/23/2010	SW051	10											113
12/18/2010	SW051	100											98.2
1/13/2010	SW052	2	9										118.1

Table A.2 2010 Selected Water Quality Results

Run Date	Site Number	Fecal Coliform (cfu/100ml)	Flow - Direction (None)	Flow (cfs)	Hardness (mg/l)	Iron (mg/l)	Lead (mg/l)	Lube Oil Range Hydrocarbons (mg/l)	Mercury (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Orthophosphate (mg/l)	Oxygen Saturation (%)
2/8/2010	SW052	1.9	1	0									126.7
3/29/2010	SW052	1.9	2										105.9
4/14/2010	SW052	1.9	3										102.1
5/12/2010	SW052	1.9	2										113.5
6/28/2010	SW052	1.9	4										143.3
7/16/2010	SW052	1.9	2										121.25
8/24/2010	SW052	1.9											134.3
9/8/2010	SW052	1.9	4										123.7
10/27/2010	SW052	28	1	0									100.7
11/15/2010	SW052	6											119.8
12/8/2010	SW052	6											105.1
1/14/2010	SW053	4											101.2
2/16/2010	SW053	400	11										88
3/10/2010	SW053	2											112.85
4/27/2010	SW053	42	11										110.5
5/25/2010	SW053	58	11										86.2
6/22/2010	SW053	11											105.8
7/29/2010	SW053	4	11										92.1
8/25/2010	SW053	10	11										129
9/9/2010	SW053	12	11										134.05
10/28/2010	SW053	58	4										97.5
11/23/2010	SW053	48											140
1/13/2010	SW055	14	1	0									41.7
2/8/2010	SW055	4		0									23.5
3/29/2010	SW055	1.9	11										82
4/14/2010	SW055	1.9	11										90.5
5/12/2010	SW055	2	11										68.1
6/28/2010	SW055	1.9	11										58
7/16/2010	SW055	1.9	11	0									83
8/24/2010	SW055	170	11										141.6
9/8/2010	SW055	1.9	11										94.7
10/27/2010	SW055	1.9	8										116.4
11/15/2010	SW055	50	11										87.5
12/8/2010	SW055	14											81.1
1/13/2010	SW056	14	1	0									60.6
2/8/2010	SW056	42	10										68.1
3/29/2010	SW056	40	11										99.4
4/14/2010	SW056	12	11										99
5/12/2010	SW056	36											77.6
6/28/2010	SW056	64	11										105.2
7/16/2010	SW056	2	1	0									175.1
8/24/2010	SW056	14											261.85
9/8/2010	SW056	46	1										308.6
10/27/2010	SW056	260	11										91.4
11/15/2010	SW056	120											88.7
12/8/2010	SW056	128											94

Table A.2 2010 Selected Water Quality Results

Run Date	Site Number	Fecal Coliform (cfu/100ml)	Flow - Direction (None)	Flow (cfs)	Hardness (mg/l)	Iron (mg/l)	Lead (mg/l)	Lube Oil Range Hydrocarbons (mg/l)	Mercury (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Orthophosphate (mg/l)	Oxygen Saturation (%)
1/14/2010	SW058	30											78.4
2/16/2010	SW058	8	1										47.8
3/10/2010	SW058	1.9	1	0									59.5
10/26/2010	SW058	160	1	0									8.4
11/23/2010	SW058	1.9	1	0									47
1/13/2010	SW059	26	11										40.3
2/8/2010	SW059	14	11										64.05
3/29/2010	SW059	130	11										85.25
4/14/2010	SW059	50	11										83.1
5/12/2010	SW059	62	11	0									69.85
6/28/2010	SW059	24	11										52
7/16/2010	SW059	240	1	0									166.2
8/24/2010	SW059	440	1	0									67.9
9/8/2010	SW059	92	1	0									78.8
10/27/2010	SW059	34	11										56
11/15/2010	SW059	20	11										66.1
12/8/2010	SW059	8	11										66.3
1/13/2010	SW072	230	1	0									72.45
2/8/2010	SW072	1.9	1	0									7.7
3/29/2010	SW072	2	1										71.9
4/14/2010	SW072	8	1										19.8
5/12/2010	SW072	22	1	0									45.4
6/28/2010	SW072	72	1	0									27.6
7/16/2010	SW072	82	1	0									32.5
8/24/2010	SW072	32	1	0									83.2
9/8/2010	SW072	80	1	0									55.9
10/27/2010	SW072	14	1	0									5.3
11/15/2010	SW072	6	1	0									48.8
12/8/2010	SW072	12	1	0									25
1/27/2010	SW118	22	11										98.6
2/8/2010	SW118	14	11										103.7
2/16/2010	SW118	40	11										103.7
2/17/2010	SW118	38	11										105.4
3/10/2010	SW118	10	11										104.9
3/24/2010	SW118	8	11										102.8
3/29/2010	SW118	82	11										100.5
4/14/2010	SW118	16	11										105.3
4/27/2010	SW118	4	11										105.75
4/28/2010	SW118	18	11										101.4
5/12/2010	SW118	8	11										104.9
5/25/2010	SW118	10	11										106.5
5/26/2010	SW118	14	11										101.6
6/22/2010	SW118	6	11										110.2
6/28/2010	SW118	46	11										105.7
6/29/2010	SW118	26	11										111.1
7/16/2010	SW118	20	11										113
7/20/2010	SW118	10	11										113.1
7/29/2010	SW118	10	11										117.8
8/24/2010	SW118	14	11										108.1

Table A.2 2010 Selected Water Quality Results

Run Date	Site Number	Fecal Coliform (cfu/100ml)	Flow - Direction (None)	Flow (cfs)	Hardness (mg/l)	Iron (mg/l)	Lead (mg/l)	Lube Oil Range Hydrocarbons (mg/l)	Mercury (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Orthophosphate (mg/l)	Oxygen Saturation (%)
8/25/2010	SW118	80	11										108.3
8/31/2010	SW118	66	11										101.7
9/6/2010	SW118	42	11										104.2
9/9/2010	SW118	36	11										104.6
9/14/2010	SW118	86	11										103.5
10/13/2010	SW118	26	11										100.4
10/26/2010	SW118	680	11										101.1
10/27/2010	SW118	86	11										103.2
11/10/2010	SW118	8	11										105.7
11/15/2010	SW118	18	11										115.1
11/23/2010	SW118	2	11										100.3
12/8/2010	SW118	12	11										100.3

Table A.3 2010 Selected Water Quality Results

Run Date	Site Number	Oxygen - Dissolved Field (mg/l)	pH - Field (pH units)	pH - Lab (pH units)	pH - Sample Temperature (deg C)	Pheophytin (ug/l)	Salinity (ppt)	Secchi Depth (cm)	Silicon (mg/l)	Specific Conductivity - Field (uS/cm)	Sulfate (mg/l)	Sulfide (mg/l)	Tin (mg/l)	Total Kjeldahl Nitrogen (mg/l)
1/25/2010	DH038	10.06	7.63		7.21		28.71	150		44938				
3/3/2010	DH038	9.3	7.85		8.685		29.13	121.9		45368				
5/13/2010	DH038	12.35	8.13		13.26		28.8	130		44597				
7/12/2010	DH038	9.58	7.92		13.95		27.74	200		43076				
9/27/2010	DH038	8.02	7.82		13.14		29.56	155.1		45653.5				
11/8/2010	DH038	8.485	7.6		9.295		29.9	180		46385.5				
12/14/2010	DH038	9.93	7.62		7.44		26.22			41366				
1/25/2010	DH039	10.275	7.63		7.355		28.475	250		44583				
3/3/2010	DH039	8.99	7.72		8.46		29.38	176.8		45745				
5/13/2010	DH039	11.09	8.03		11.95		28.78	190		44623				
7/12/2010	DH039	9.3	7.9		13.36		27.86	260		43261				
9/27/2010	DH039	7.99	7.84		12.31		29.59	229.8		45741				
11/8/2010	DH039	8.48	7.62		9.38		29.82	230		46275				
12/14/2010	DH039	9.8	7.62		7.48		25.68	75		40580				
1/25/2010	DH040	9.98	7.61		7.37		28.28	140.2		44302				
3/3/2010	DH040	8.48	7.65		8.26		29.41			45808				
5/13/2010	DH040	10.8	8		11.93		28.76	170		44599.5				
7/12/2010	DH040	9.44	7.92		13.435		27.645	250		42965				
9/27/2010	DH040	8.19	7.78		12.51		29.63	200		45787				
11/8/2010	DH040	8.49	7.62		9.42		29.74	220		46148				
12/14/2010	DH040	9.67	7.62		7.62		26.06			41107				
1/25/2010	DH041	9.62	7.65		7.45		28.56	250		44255				
3/3/2010	DH041	8.36	7.65		8.28		29.53	137.2		45970				
5/13/2010	DH041	11.03	8.03		12.19		28.76	150		44588				
7/12/2010	DH041	10.18	7.92		13.57		27.8	218.45		43183				
9/27/2010	DH041	8.98	7.91		12.68		29.63	169.8		45774				
11/8/2010	DH041	8.61	7.6		9.35		29.77	190		46197				
1/25/2010	DH042	9.82	7.62		7.1		28.66	250		44879				
3/3/2010	DH042	9.47	7.83		8.82		29.08	146.3		45279				
5/13/2010	DH042	15.76	8.44		15.65		28.86	160		44618				
7/12/2010	DH042	10.5	7.96		15.78		27.34	190		42519				
9/27/2010	DH042	8.08	7.89		13.59		29.37	185.1		45351				
11/8/2010	DH042	8.72	7.58		8.99		29.58	210		45968				
1/25/2010	DH043	10.19	7.64		7.38		28.31	310		44355				
3/3/2010	DH043	9.13	7.77		8.48		29.36	146.3		45705				
5/13/2010	DH043	13.11	8.13		13.78		28.71	190		44442				
7/12/2010	DH043	8.86	7.69		14.45		27.41	130		42573				
9/27/2010	DH043	9.08	7.99		14.14		29.37	230		45343				
11/8/2010	DH043	8.65	7.61		9.35		29.74	280		46158				
1/25/2010	DH044	12.3	7.92		6.6		27.59			43415				
3/3/2010	DH044	9.78	7.93		9.51		28.27			44070				
5/13/2010	DH044	8.95	7.91		19.52		29.48			45430.5				
7/12/2010	DH044	7.5	7.78		20.59		29.82			45913				
9/27/2010	DH044	8.08	7.89		18.71		29.02			44786				

Table A.3 2010 Selected Water Quality Results

Run Date	Site Number	Oxygen - Dissolved Field (mg/l)	pH - Field (pH units)	pH - Lab (pH units)	pH - Sample Temperature (deg C)	Pheophytin (ug/l)	Salinity (ppt)	Secchi Depth (cm)	Silicon (mg/l)	Specific Conductivity - Field (uS/cm)	Sulfate (mg/l)	Sulfide (mg/l)	Tin (mg/l)	Total Kjeldahl Nitrogen (mg/l)
12/14/2010	DH044	10.48	7.655		6.525		25.89			40989				
1/25/2010	DH045	13.695	8.095		6.885		28.245			44314				
3/3/2010	DH045	13.09	8.175		9.57		28.385			44238.5				
5/13/2010	DH045	10.72	8.08		17.79		29.41			45323				
7/12/2010	DH045	6.53	7.785		19.625		29.55			45525				
9/27/2010	DH045	9.66	8.205		18.23		29.2			45037.5				
11/8/2010	DH045	13.43	8.11		9.85		28.26			44040				
12/14/2010	DH045	11.155	7.865		6.515		25.835			40910.5				
1/27/2010	DH048						22							
3/24/2010	DH048						22							
5/26/2010	DH048						25							
7/20/2010	DH048						15							
9/14/2010	DH048						20							
11/16/2010	DH048						28							
1/27/2010	DH049						2							
3/24/2010	DH049						0							
5/26/2010	DH049						22							
7/20/2010	DH049						4							
9/14/2010	DH049						18							
11/16/2010	DH049						0							
12/14/2010	DH049	11.24	7.69		7.02		15.51			25622				
1/27/2010	DH050						0							
3/24/2010	DH050						0							
5/26/2010	DH050						21							
7/20/2010	DH050						2							
9/14/2010	DH050						20							
11/16/2010	DH050						0							
1/27/2010	DH051						0							
3/24/2010	DH051						0							
5/26/2010	DH051						18							
7/20/2010	DH051						2							
9/14/2010	DH051						20							
11/16/2010	DH051						0							
1/27/2010	DH052						0							
3/24/2010	DH052						1							
5/26/2010	DH052						15							
7/20/2010	DH052						4							
9/14/2010	DH052						12							
11/16/2010	DH052						0							
12/14/2010	DH052	12.1	7.61		6.44		8.99			15564				
1/27/2010	DH053						4							
3/24/2010	DH053						20							
5/26/2010	DH053						20							
7/20/2010	DH053						12							

Table A.3 2010 Selected Water Quality Results

Run Date	Site Number	Oxygen - Dissolved Field (mg/l)	pH - Field (pH units)	pH - Lab (pH units)	pH - Sample Temperature (deg C)	Pheophytin (ug/l)	Salinity (ppt)	Secchi Depth (cm)	Silicon (mg/l)	Specific Conductivity - Field (uS/cm)	Sulfate (mg/l)	Sulfide (mg/l)	Tin (mg/l)	Total Kjeldahl Nitrogen (mg/l)
9/14/2010	DH053						10							
11/16/2010	DH053						0							
1/27/2010	DH054					4								
3/24/2010	DH054					20								
5/26/2010	DH054					20								
7/20/2010	DH054					11								
9/14/2010	DH054					22								
11/16/2010	DH054					0								
1/27/2010	DH055					8								
3/24/2010	DH055					4								
5/26/2010	DH055					22								
7/20/2010	DH055					6								
9/14/2010	DH055					20								
11/16/2010	DH055					0								
1/27/2010	DH057					0								
3/24/2010	DH057					5								
5/26/2010	DH057					22								
7/20/2010	DH057					4								
9/14/2010	DH057					10								
11/16/2010	DH057					0								
12/14/2010	DH057	11.47	7.56		6.78		12.09			20442				
1/27/2010	DH058					8								
3/24/2010	DH058					7								
5/26/2010	DH058					20								
7/20/2010	DH058					8								
9/14/2010	DH058					10								
11/16/2010	DH058					0								
1/27/2010	DH271					0								
3/24/2010	DH271					0								
5/26/2010	DH271					18								
7/20/2010	DH271					0								
9/14/2010	DH271					18								
12/14/2010	DH271	12.31	7.73		6.31		7			12283				
1/27/2010	DH272					0								
3/24/2010	DH272					0								
5/26/2010	DH272					21								
7/20/2010	DH272													
9/14/2010	DH272													
11/16/2010	DH272													
1/25/2010	DH285	11.1	7.65		5.49		26.65	30		42206				
3/3/2010	DH285	9.92	7.95		9.11		28.69	88.4		44698				
5/13/2010	DH285	11.54	8.05		13.75		29.08	120		44957				
7/12/2010	DH285	8.68	7.9		15.17		27.58	110		42822				
9/27/2010	DH285	8.23	7.82		14.04		29.12	129.9		45005				

Table A.3 2010 Selected Water Quality Results

Run Date	Site Number	Oxygen - Dissolved Field (mg/l)	pH - Field (pH units)	pH - Lab (pH units)	pH - Sample Temperature (deg C)	Pheophytin (ug/l)	Salinity (ppt)	Secchi Depth (cm)	Silicon (mg/l)	Specific Conductivity - Field (uS/cm)	Sulfate (mg/l)	Sulfide (mg/l)	Tin (mg/l)	Total Kjeldahl Nitrogen (mg/l)
11/8/2010	DH285	9.3	7.56		9.12		29.32	150		45596				
12/14/2010	DH285	10.74	7.55		7.04		16.96			30780				
1/25/2010	DH286	10.56	7.63		6.72		28.67	81		44960				
3/3/2010	DH286	9.35	7.9		9.33		27.88	51.8		43547				
5/13/2010	DH286	12.19	8.36		18.22		26.93	50		44666				
7/12/2010	DH286	9.99	8.05		16.92		27.36	100		42485				
9/27/2010	DH286	5.72	7.39		16.05		28.05	80		43465				
11/8/2010	DH286	9.42	7.51		8.94		29.58	90		45960				
12/14/2010	DH286	10.94	7.58		6.4		22.79			36533				
1/25/2010	DH287	10.65	7.62		6.01		26.44	90		44711				
3/3/2010	DH287	9.93	7.92		8.95		26.66	121.92		44686				
5/13/2010	DH287	11.04	7.91		12.64		28.79	160		44606				
7/12/2010	DH287	10.4	7.9		13.31		28	198.12		43467				
9/27/2010	DH287	7.78	7.78		12.26		29.72	165		45924				
11/8/2010	DH287	8.56	7.59		9.24		29.95	180						
12/14/2010	DH287	10.94	7.61		7.37		26.44			41680				
1/25/2010	DH288	10.26	7.36		7.1		26.31	99		44378				
3/3/2010	DH288	9.4	7.81		8.92		27.83	82.3		43508				
5/13/2010	DH288	11.58	8.14		14.46		28.74	80		44459				
7/12/2010	DH288	9.94	8.04		14.83		27.53	106.68		42750				
9/27/2010	DH288	7.94	7.75		13.51		29.48	80		45536				
11/8/2010	DH288	8.71	7.24		9.14		29.92			46439				
12/14/2010	DH288	10.38	7.42		7.19		26.33			41542				
1/26/2010	SW001	9.64	7.43	7.6	7.04		28.02	260		43988			0.0045	
2/9/2010	SW001	8.54	6.96		7.7		29.05	340		45362				
3/15/2010	SW001	9.77	7.44		7.62		28.46	280		44529				
4/6/2010	SW001	10.84	7.87		9.17		28.17	250		43961				
5/7/2010	SW001	9.595	7.77		13.035		28.585	280		44292.5				
6/8/2010	SW001	10.46	7.91		16.4		28.17	250		43617				
7/19/2010	SW001	10.49	7.91		17.36		27.29	160		42377				
8/17/2010	SW001	8.83	7.26		17.64		27.94	90		43301				
9/7/2010	SW001	6.83	7.53		14.82		28.43	210		44018				
10/12/2010	SW001	7.66	7.35		12.14		29.14	190		45115				
11/9/2010	SW001	10.24	7.43		8.89		29.23			45485				
1/26/2010	SW002	9.8	7.69	7.9	7.05	1.7	28.53	174	1.97	44673	2580	0.225		0.36
2/9/2010	SW002	8.73	7.5		7.74		29.49	171		45967				
3/15/2010	SW002	10.77	7.97		8.53		29.16	76.2		45427				
4/6/2010	SW002	11.96	7.69		8.74		28.45	120		44400				
5/7/2010	SW002	11.84	8.12		12.75		28.11	110		43631				
6/8/2010	SW002	16.46	8.38		14.33		26.35	100		43914				
7/19/2010	SW002	11.46	8.11		14.06		28.22	140.21		43745				
8/17/2010	SW002	11.89	7.98		14.75		27.67	153		42938				
9/7/2010	SW002	8.81	7.95		12.96		29.04	153		44931				
10/12/2010	SW002	7.975	7.7		11.11		29.98	200		46359.5				

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Run Date	Site Number	Oxygen - Dissolved Field (mg/l)	pH - Field (pH units)	pH - Lab (pH units)	pH - Sample Temperature (deg C)	Pheophytin (ug/l)	Salinity (ppt)	Secchi Depth (cm)	Silicon (mg/l)	Specific Conductivity - Field (uS/cm)	Sulfate (mg/l)	Sulfide (mg/l)	Tin (mg/l)	Total Kjeldahl Nitrogen (mg/l)
11/9/2010	SW002	10.66	7.67		9.2		29.675			46087				
1/14/2010	SW003	7.64	7.27	6.5	7.68	0.27	0.17		7.22	350	32	0.05		0.99
2/16/2010	SW003	10.74	6.85		7.52		0.07			138				
3/10/2010	SW003	9.43	7.31		5.98		0.38			774				
4/27/2010	SW003	7.83	7.23		11.36		0.44			883				
5/25/2010	SW003	6.14	7.27		14.98		0.71			1407				
6/22/2010	SW003	2.81	6.92		13.99		0.41			831				
7/29/2010	SW003	7.08	7.98		21.7		19.8			31840				
8/25/2010	SW003	5.54	8.3		18.53		31.15			47727				
9/9/2010	SW003	4.11	7.88		16.89		29.91			46033				
10/26/2010	SW003	3.87	6.98		9.71		0.74			1454				
11/23/2010	SW003	4.4	7.24		-0.27		0.39			817				
1/13/2010	SW004	12.82	7.15		5.9		0.02			55				
1/14/2010	SW004	13	7.07		6.22		0.04			76				
1/26/2010	SW006	10.05	7.71	7.8	6.92	15	23.52	180	2.87	38990	1880	0.225		0.21
2/9/2010	SW006	9.9	7.64		7.67		24.84	270		39356				
3/15/2010	SW006	10.81	8		8.36		18.01	160		29292				
4/6/2010	SW006	11.46	8.01		9.09		25.39	170		40028				
5/7/2010	SW006	11.11	7.96		12		11.33	160		18985				
6/8/2010	SW006	13.15	8.265		15.485		18.61	110		29951				
7/19/2010	SW006	9.95	8.31		18.1		15.24	170		24928				
8/17/2010	SW006	12.565	7.49		18.87		24.86	200		38954.5				
9/7/2010	SW006	9.91	8.09		15.43		24.41	210		38349				
10/12/2010	SW006	10.11	7.31		12.72		11.5	40		19287				
11/9/2010	SW006	12.14	7.71		8.77		20.68			33212				
1/27/2010	SW007	12.635	7.635		5.43		0.06			124				
2/17/2010	SW007	13.125	7.805		5.935		0.04			84.5				
3/24/2010	SW007	12.54	7.95		9.43		0.05			115				
4/28/2010	SW007	11.65	7.6		9.97		0.04			88				
5/26/2010	SW007	10.97	7.86		11.57		0.05			100				
6/29/2010	SW007	11.98	7.93		11.805		0.03			71				
7/20/2010	SW007	10.95	8.22		16.06		0.04			85				
8/31/2010	SW007	7.945	7.63		13.765		0.05			111.5				
9/14/2010	SW007	10.37	7.86		13.58		0.04			86				
10/13/2010	SW007	11.295	7.96		10.545		0.05			104				
11/10/2010	SW007	13.09	8.04		6.77		0.04			90				
1/14/2010	SW008	9.77	7.59		7.25		1.87			3551				
2/16/2010	SW008	8.58	7.07		8.56		0.71			1419				
3/10/2010	SW008	9.26	7.26		6.94		7.63			13300				
4/27/2010	SW008	6.59	7.43		14.81		1.23			2378				
5/25/2010	SW008	4.73	7.53		18.74		6.98			12146				
6/22/2010	SW008	5.35	7.51		19.07		1.3			2505				
7/29/2010	SW008	3.09	7.42		22.82		22.2			35204				
8/25/2010	SW008	2.31	7.41		22.89		29.79			45911				

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Run Date	Site Number	Oxygen - Dissolved Field (mg/l)	pH - Field (pH units)	pH - Lab (pH units)	pH - Sample Temperature (deg C)	Pheophytin (ug/l)	Salinity (ppt)	Secchi Depth (cm)	Silicon (mg/l)	Specific Conductivity - Field (uS/cm)	Sulfate (mg/l)	Sulfide (mg/l)	Tin (mg/l)	Total Kjeldahl Nitrogen (mg/l)
9/9/2010	SW008	2.9	7.29		18.7		27.92			43276				
10/26/2010	SW008	9.06	7.49		8.44		24.03			38131				
1/14/2010	SW009	9.9	6.87	6.5	6.47	1.3	0.09		7.87	194	8.3	0.09		0.38
2/16/2010	SW009	10.55	7		8.85		0.37			755				
3/10/2010	SW009	13.04	7.06		7.21		0.43			875				
4/27/2010	SW009	14.72	7.35		14.04		0.43			874				
5/25/2010	SW009	4.395	7.395		13.525		0.64			1278.5				
6/22/2010	SW009	4.06	7.32		16.2		0.44			892				
7/29/2010	SW009	6.6	7.7		20.68		4.19			7512				
8/25/2010	SW009	18.48	8.51		17.57		17.73			28647				
9/9/2010	SW009	5.42	7.98		18.66		17.5			28333				
10/26/2010	SW009	5.33	7.36		8.52		1.96			3712				
1/14/2010	SW010	7.07	6.52		7.65		0.25			507				
2/16/2010	SW010	6.86	6.53		9.04		0.62			1235				
3/10/2010	SW010	7	6.58		7.08		0.89			1758				
5/25/2010	SW010	6.72	7.25		16.92		0.96			1886				
6/22/2010	SW010	4.92	6.69		17.54		0.95			1869				
7/29/2010	SW010	15.59	8.53		22.43		1.83			3485				
8/25/2010	SW010	0.3	7.44		22.92		13.69			22669				
9/9/2010	SW010	3.15	7.37		20.1		12.89			22356				
10/26/2010	SW010	2.84	7.02		9.24		0.73			1437				
1/14/2010	SW011	12.42	7.29		7.45		0.06			121				
2/16/2010	SW011	12.33	6.74		7.92		0.04			95				
3/10/2010	SW011	13.3	7.6		5.93		0.07			154				
4/27/2010	SW011	11.41	7.45		11.305		0.08			160.5				
5/25/2010	SW011	10.99	7.46		11.72		0.09			187				
6/22/2010	SW011	10.81	7.435		14.085		0.09			197.5				
7/29/2010	SW011	10.49	8.03		15.6		0.15			313				
8/25/2010	SW011	7.755	7.675		14.5		0.18			370.5				
9/9/2010	SW011	8.21	7.31		12.88		0.14			289				
10/26/2010	SW011	10.87	7.46		9.09		0.11			222				
11/23/2010	SW011	8.05	7.53		-0.17		0.09			197				
1/14/2010	SW012	7.105	6.85		7.77		0.11			207.5				
2/16/2010	SW012	9.535	6.92		8.31		0.11			228				
3/10/2010	SW012	9.92	6.93		6.61		0.14			302				
4/27/2010	SW012	4.86	7.49		12.78		0.1			215				
5/25/2010	SW012	4.94	7.34		13.56		0.71			1400				
6/22/2010	SW012	4.16	7.23		16.11		0.16			324				
7/29/2010	SW012	20.41	8		23.12		6.57			11530				
8/25/2010	SW012	10.84	8.02		18.32		22.04			34937				
9/9/2010	SW012	9.53	7.83		16.85		22.51			35616				
10/26/2010	SW012	5.78	7.01		9.51		0.16			332				
11/23/2010	SW012	11.8	6.79		0.36		0.11			242				
1/14/2010	SW013	7.91	7.05		7.77		0.22			462				

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Run Date	Site Number	Oxygen - Dissolved Field (mg/l)	pH - Field (pH units)	pH - Lab (pH units)	pH - Sample Temperature (deg C)	Pheophytin (ug/l)	Salinity (ppt)	Secchi Depth (cm)	Silicon (mg/l)	Specific Conductivity - Field (uS/cm)	Sulfate (mg/l)	Sulfide (mg/l)	Tin (mg/l)	Total Kjeldahl Nitrogen (mg/l)
2/16/2010	SW013	7.88	6.82		9.08		0.41			833				
3/10/2010	SW013	3.5	6.75		7.28		0.77			1527				
4/27/2010	SW013	5.19	6.93		13.26		0.49			988				
5/25/2010	SW013	14.43	7.26		16.76		0.74			1466				
6/22/2010	SW013	2.79	6.96		19.96		0.77			1529				
7/29/2010	SW013	19.38	7.95		20.68		3.08			5683				
8/25/2010	SW013	33.37	9.05		19.46		5.01			8927				
9/9/2010	SW013	34.33	8.68		17.69		5.04			8979				
10/26/2010	SW013	4.25	6.97		9.53		0.94			1836				
1/14/2010	SW014	9.06	7.8	6.2	7.34		0.06			120				
2/16/2010	SW014	10.85	6.8		7.99		0.05			114				
3/10/2010	SW014	10.57	8.07		5.14		0.06			132				
4/27/2010	SW014	8.87	7.34		10.59		0.07			147				
5/25/2010	SW014	8.13	7.4		13.57		0.09			183.5				
6/22/2010	SW014	8.04	7.25		14.07		0.08			177				
9/9/2010	SW014	4.42	7.06		14.32		0.07			155				
10/26/2010	SW014	8.815	7.53		9.04		0.105			219				
11/23/2010	SW014	6.575	8.08		0.35		0.095			202				
1/13/2010	SW015	4.92	6.21	6.1	7.68	10	0.14	7.73		293	28		0.09	1.6
2/8/2010	SW015	5.14	6.58		7.83		0.95			1872				
3/29/2010	SW015	8.34	6.74		8.91		0.8			1580				
4/14/2010	SW015	6.3	7.2		12.7		1.22			2356				
5/12/2010	SW015	9.4	6.8	6.7	16.5	0.27	1.08		10.3	2104	360			0.86
6/28/2010	SW015	3.525	6.685		16.655		1.375			2642.5				
7/16/2010	SW015	4.77	7.45		17.3		1.61			3070				
8/24/2010	SW015	8.97	8.05		16.04		1.61			3063				
9/8/2010	SW015	3.62	7.085		13.955		0.13			277.5				
10/27/2010	SW015	5.27	6.9		9.72		0.45			901				
11/15/2010	SW015	7.41	6.74		8.99		1.17			2266				
12/8/2010	SW015	9.86	7.14		6.31		0.88			1733				
1/13/2010	SW016	4.52	6.71		8.11		0.26			533				
2/8/2010	SW016	3.18	6.57		8.17		0.44			885				
3/29/2010	SW016	9.53	6.85		9.64		0.31			629				
4/14/2010	SW016	5.37	6.82		11.54		0.41			824				
5/12/2010	SW016	2.49	6.59		12.96		0.45			910				
6/28/2010	SW016	1.29	6.85		16.14		0.45			916				
7/16/2010	SW016	8.78	7.26		19.79		0.58			1166				
10/27/2010	SW016	2.97	6.82		10.83		0.67			1340				
11/15/2010	SW016	5.21	6.73		9.77		0.37			744				
12/8/2010	SW016	6.75	6.8		8.13		0.43			879				
1/13/2010	SW017	8.69	6.67		8.4		0.41			827				
2/8/2010	SW017	4.23	6.77		7.94		0.87			1722				
3/29/2010	SW017	9.09	6.95		10.12		0.69			1376				
4/14/2010	SW017	2.63	6.74		11.65		0.86			1698				

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5/12/2010	SW017	4.18	6.72		13.18		1.25			2401				
6/28/2010	SW017	2.65	7.07		16.39		0.84			1650				
7/16/2010	SW017	0.8	7.22		21.34		1.07			2088				
10/27/2010	SW017	3.78	6.64		11		0.94			1854				
11/4/2010	SW017	1.35	6.63		9.22		0.73			1449				
12/8/2010	SW017	8.89	7.06		7.61		0.83			1640				
1/26/2010	SW019	9.2	7.145		7.28		28.46	290		44574.5				
2/9/2010	SW019	8.79	7.48		7.74		29.25	390		45638				
3/15/2010	SW019	9.37	7.83		7.88		29.18	115.8		45524				
4/6/2010	SW019	10.71	7.92		9.2		28.2	310		44006				
5/7/2010	SW019	9.72	7.87		12.63		28.46	330		44143				
6/8/2010	SW019	10.73	8.06		14.97		27.98	240		43389				
7/19/2010	SW019	10.87	8.15		15.59		26.46	170		41234				
8/17/2010	SW019	9.39	7.46		16.05		27.22	310		42296				
9/7/2010	SW019	7.47	7.76		14.31		28.12	290		43600				
10/12/2010	SW019	7.78	7.6		12.05		29.64	290		45823				
11/9/2010	SW019	9.66	7.56		9.13		29.7			46121				
1/26/2010	SW022	9.42	7.47		7.47		28.77	216		44984				
2/9/2010	SW022	9.92	7.5		7.08		29	192		45372				
3/15/2010	SW022	11.24	8.06		8.46		27.29	106.7		42772				
4/6/2010	SW022	11.725	8.04		9.57		26.16	112.5		41075.5				
5/7/2010	SW022	10.44	8.05		12.39		28.32	90		43952				
6/8/2010	SW022	12.74	8.4		15.83		27.72	60		43000				
7/19/2010	SW022	11.26	8.18		15.11		24.74	440		38820				
8/17/2010	SW022	10.54	7.86		15.1		26.68	144		41562				
9/7/2010	SW022	7.47	7.83		12.525		29.23	117		45220.5				
10/12/2010	SW022	8.01	7.69		11.09		29.96	210		46322				
11/9/2010	SW022	10.43	7.62		9.1		29.74	160		46190				
1/26/2010	SW023	11.06	7.68		4.84		20.03	222		32566				
2/9/2010	SW023	10.51	7.59		6.33		22.91	160		36690				
3/15/2010	SW023	10.69	7.985		8.755		16.975	125		27725.5				
4/6/2010	SW023	11.045	7.98		8.955		26.61	150		41773.5				
5/7/2010	SW023	11.57	8.07		10.06		1.52	160		2920				
6/8/2010	SW023	12.93	8.22		15.72		18.4	140		29638				
7/19/2010	SW023	9.835	8.335		18.765		11.475	170		19234				
8/17/2010	SW023	12.03	8.16		19.28		24.5	190		38461				
9/7/2010	SW023	9.88	8.02		14.97		25.35	160		39661				
10/12/2010	SW023	10.07	7.7		12.83		8.91	50		15236				
11/9/2010	SW023	13.14	7.77		8.33		16.36	160		26822				
2/9/2010	SW025	11.65	7.9		6.27		0.07	153		153				
3/15/2010	SW025	10.22	7.74		9.6		0.1	217		217				
4/6/2010	SW025	9.4	7.4		8.67		0.11	228		228				
1/26/2010	SW026	10.33	7.53		5.43		21.6	34823		34823				
2/9/2010	SW026	11.99	7.24		7.155		12.42	20319.5		20319.5				

Table A.3 2010 Selected Water Quality Results

Run Date	Site Number	Oxygen - Dissolved Field (mg/l)	pH - Field (pH units)	pH - Lab (pH units)	pH - Sample Temperature (deg C)	Pheophytin (ug/l)	Salinity (ppt)	Secchi Depth (cm)	Silicon (mg/l)	Specific Conductivity - Field (uS/cm)	Sulfate (mg/l)	Sulfide (mg/l)	Tin (mg/l)	Total Kjeldahl Nitrogen (mg/l)
3/15/2010	SW026	12.59	7.885		13.125		9.155			15208.5				
4/6/2010	SW026	14.155	7.93		9.745		17.43			28041.5				
5/7/2010	SW026	7.38	7.38		17.87		1.27			2445				
6/8/2010	SW026	9.325	7.935		21.795		11.37			18693.5				
9/7/2010	SW026	7.08	7.16		8.56		22.61			35762				
11/9/2010	SW026	13.295	7.54		5.67		18.21			29545				
1/26/2010	SW027	11.58	7.53		5.67		20.45			33940				
2/9/2010	SW027	11	7.79		7.9		6.566666667			10630.66667				
3/4/5/2010	SW027	11.655	8.175		11.52		6.26			11472				
4/6/2010	SW027	12.53	8.09		9.18		12.875			20271				
5/7/2010	SW027	10.49	7.485		13.775		1.88			3433.5				
6/8/2010	SW027	9.836666667	7.71666667		17.41		6.443333333			10369.33333				
1/26/2010	SW028	11.97	7.29		3.82		19.09			31301				
2/9/2010	SW028	14.63	7.825		9.23		17.43			28365.5				
3/4/5/2010	SW028	12.89666667	8.213333333		14.59		5.96			10189.33333				
4/6/2010	SW028	11.87	7.22		9.24		17.185			27761				
5/7/2010	SW028	9.3	7.74		16.95		10			16938				
6/8/2010	SW028	11.88	7.955		21.48		16.34			26566				
7/1/9/2010	SW028	6.92	7.65		22.35		22.35			35432				
8/17/2010	SW028	7.48	7.6		25.37		24.77			38945				
9/7/2010	SW028	9.78	7.61		18.53		24.16			37973				
10/12/2010	SW028	11.09	7.805		14.04		9.56			16228				
11/9/2010	SW028	13.22	7.565		8.67		18.725			30338				
1/27/2010	SW029	13.97	5.95		3.51		0.05			96				
2/17/2010	SW029	12.99	5.78		5.28		0.05			99				
3/24/2010	SW029	12.19	5.81		7.19		0.05			104				
4/28/2010	SW029	11.05	6.19		9.63		0.05			103				
5/26/2010	SW029	10.81	6.2		10.95		0.05			113				
6/29/2010	SW029	11.09	6.4		12.19		0.06			115				
10/13/2010	SW029	7.8	6.24		9.7		0.05			125				
11/10/2010	SW029	11.09	6.16		6.99		0.06			131				
1/27/2010	SW030	12.83	7.43		5.41		3.33			6145				
2/17/2010	SW030	11.29	7.85		11.56		25.85			40509				
3/24/2010	SW030	12.09	8.07		10.75		23.7			37594				
4/28/2010	SW030	8.97	7.92		17.955		6.63			11578				
5/26/2010	SW030	12.5	8.06		14.47		25.14			39400				
6/29/2010	SW030	9.635	8.54		19.42		1.6			3061.5				
7/20/2010	SW030	10.54	8.26		21.23		3.6			6576				
8/31/2010	SW030	9.33	7.97		14.47		24.64			38486				
9/14/2010	SW030	9.27	8		15.43		24.86			38977				
10/13/2010	SW030	9.59	7.92		13.48		22.31			35322				
11/10/2010	SW030	10.39	7.68		9.36		22.55			35867				
1/27/2010	SW031	9.63	5.88		4.8		0.04			93				
2/17/2010	SW031	10.53	6		7.14		0.04			83				

Table A.3 2010 Selected Water Quality Results

Run Date	Site Number	Oxygen - Dissolved Field (mg/l)	pH - Field (pH units)	pH - Lab (pH units)	pH - Sample Temperature (deg C)	Pheophytin (ug/l)	Salinity (ppt)	Secchi Depth (cm)	Silicon (mg/l)	Specific Conductivity - Field (uS/cm)	Sulfate (mg/l)	Sulfide (mg/l)	Tin (mg/l)	Total Kjeldahl Nitrogen (mg/l)
3/24/2010	SW031	11.13	6.89		10.26		0.04			87				
4/28/2010	SW031	8.19	6.72		12.23		0.04			94				
6/29/2010	SW031	5.06	6.5		16.19		0.07			152				
1/27/2010	SW032	12.95	6.42		4.58		4.96			8960				
2/17/2010	SW032	10.99	7.52		9.03		25.68			40430				
3/24/2010	SW032	14.37	8.14		9.87		26.25			41172				
4/28/2010	SW032	11.16	7.86		14.32		15.03			24655				
5/26/2010	SW032	13.485	8.35		13.965		19.885			31844				
6/29/2010	SW032	16.87	9.42		20.4		6.09			10768				
7/20/2010	SW032	10.61	8.1		20.33		3.09			5698				
8/31/2010	SW032	9.02	7.96		14.24		27.31			42462				
9/14/2010	SW032	9.32	7.975		15.06		21.425			34062				
10/13/2010	SW032	9.66	7.88		12.53		15.22			24944				
11/10/2010	SW032	10.87	7.28		8.53		17.26			28153				
1/27/2010	SW033	8.085	6.175		4.64		0.045			91				
2/17/2010	SW033	9.485	6.405		6.875		0.04			94				
3/24/2010	SW033	10.01	7.47		9.285		0.05			101.5				
4/28/2010	SW033	8.505	6.81		11.705		0.05			104.5				
6/29/2010	SW033	5.14	7.26		15.85		0.13			281				
1/27/2010	SW034	13.2	6.92		4.18		3.95			7227				
2/17/2010	SW034	11.09	7.79		9.22		25.8			40142				
3/24/2010	SW034	14.3	8.22		9.48		22.68			36084				
4/28/2010	SW034	11.65	8.08		13.5		14.15			23317				
5/26/2010	SW034	16.35	8.44		13.73		20.6			32894				
6/29/2010	SW034	17.51	9.08		17.14		3.55			6356				
7/20/2010	SW034	11.565	8.55		19.005		5.69			10113				
8/31/2010	SW034	9.32	8.01		14.24		27.28			42418				
9/14/2010	SW034	9.12	7.96		15.21		22.51			35626				
10/13/2010	SW034	9.98	7.89		12.75		15.52			25355				
11/10/2010	SW034	10.9	7.7		9.05		16.71			27313				
1/27/2010	SW035	8.79	7.34		4.02		0.28			573				
2/17/2010	SW035	10.35	6.98		6.56		0.07			150				
4/28/2010	SW035	8.76	7.7		12.05		0.22			450				
1/27/2010	SW036	13.7	7.05		2.86		6.48			1554				
2/17/2010	SW036	10.24	7.47		8		22.13			36075				
3/24/2010	SW036	12.86	8.04		9.42		15.5			24500				
4/28/2010	SW036	10.6	7.93		12.33		11.25			18907				
5/26/2010	SW036	12.67	8.33		13.16		18.51			29844				
6/29/2010	SW036	13.23	8.57		17.29		5.12			9182				
7/20/2010	SW036	11.42	8.44		19.38		4.66			8354				
8/31/2010	SW036	9.2	7.9		14.05		27.03			42070				
9/14/2010	SW036	6.99	7.72		14.48		24.44			38594				
10/13/2010	SW036	9.69	7.86		12.32		14.38			23676				
11/10/2010	SW036	10.86	7.77		9.19		16.38			26807				

Table A.3 2010 Selected Water Quality Results

Run Date	Site Number	Oxygen - Dissolved Field (mg/l)	pH - Field (pH units)	pH - Lab (pH units)	pH - Sample Temperature (deg C)	Pheophytin (ug/l)	Salinity (ppt)	Secchi Depth (cm)	Silicon (mg/l)	Specific Conductivity - Field (uS/cm)	Sulfate (mg/l)	Sulfide (mg/l)	Tin (mg/l)	Total Kjeldahl Nitrogen (mg/l)
2/17/2010	SW037	8.95	7.18		8.58		0.21			429				
3/24/2010	SW037	8.64	7.64		10		0.18			380				
1/27/2010	SW038	13.75	7.78		7.78		2.53			12370				
2/17/2010	SW038	10.43	7.53		7.68		17.19			28128				
3/24/2010	SW038	12.46	8.24		9.49		5.75			10170				
4/28/2010	SW038	16.39	8.45		14.17		28.34			43916				
5/26/2010	SW038	14.9	8.29		12.9		26.26			41029				
6/29/2010	SW038	10.77	8.09		15.91		2082			33246				
7/20/2010	SW038	11.74	8.48		18.5		7.39			12802				
8/31/2010	SW038	8.97	7.88		14.25		27.13			42213				
9/14/2010	SW038	7.08	7.68		14.38		24.19			38047				
10/13/2010	SW038	9.72	7.88		11.53		15.37			25212				
11/10/2010	SW038	10.98	7.63		8.32		15.91			26140				
1/27/2010	SW039	9.42	7.31		7.5		28.48			44594				
2/17/2010	SW039	10.57	7.28		8.67		26.24			44107				
3/24/2010	SW039	11.73	7.68		10.19		11.21			18911				
4/28/2010	SW039	18.25	8.37		12.39		28.68			44465				
5/26/2010	SW039	11.69	7.71		12.19		25.61			40140				
6/29/2010	SW039	13.17	8.1		14.31		24.33			38231				
7/20/2010	SW039	16.79	8.1		17.47		25.56			39952				
8/31/2010	SW039	8.76	7.79		14.15		26.92			41917				
9/14/2010	SW039	7.77	7.6		13.8		25.94			40542				
10/13/2010	SW039	8.22	7.77		11.46		24.87			39405				
11/10/2010	SW039	9.2	9.69		8.02		27.62			43137				
1/13/2010	SW051	9.95	7		8.02		9.55			16341				
1/14/2010	SW051	10.57	7.09		7.59		19.83			32042				
2/8/2010	SW051	10.08	7.44		8.1		21.5			34218				
2/16/2010	SW051	9.59	6.64		8.29		15.61			25690				
3/10/2010	SW051	11.11	7.33		6.59		24.82			39436				
3/29/2010	SW051	10.06	7.36		9.47		12.57			21011				
4/14/2010	SW051	9.66	7.57		15.76		14.36			23614				
4/27/2010	SW051	10.36	7.67		14.68		13.19			21871				
5/12/2010	SW051	9.64	8.04		16.68		17.97			29010				
5/25/2010	SW051	8.3	7.88		18.38		23.41			36898				
6/22/2010	SW051	10.85	7.73		20.37		14.56			23940				
6/28/2010	SW051	5.86	7.63		19.58		22.48			35576				
7/16/2010	SW051	6.6	7.66		22.38		27.56			42802				
7/29/2010	SW051	5.65	7.66		22.58		28.68			44356				
8/24/2010	SW051	6.36	7.85		23.02		30.28			46592				
8/25/2010	SW051	5.75	7.99		21.85		30.43			46778				
9/8/2010	SW051	8.17	7.97		18.79		28.58			44184				
9/9/2010	SW051	6.59	7.8		19.25		29.19			45031				
10/26/2010	SW051	9.5	7.56		8.25		28.93			45128				
10/27/2010	SW051	8.46	7.56		9.53		28.75			44747				
11/15/2010	SW051	10	7.54		8.67		27.82			43560				
11/23/2010	SW051	14	5.3		-1.58		29.37			47948				
12/8/2010	SW051	9.77	7.46		7.39		28.99			45317				
1/13/2010	SW052	11.58	7.69		8.48		27.24			42709				

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Run Date	Site Number	Oxygen - Dissolved Field (mg/l)	pH - Field (pH units)	pH - Lab (pH units)	pH - Sample Temperature (deg C)	Pheophytin (ug/l)	Salinity (ppt)	Secchi Depth (cm)	Silicon (mg/l)	Specific Conductivity - Field (uS/cm)	Sulfate (mg/l)	Sulfide (mg/l)	Tin (mg/l)	Total Kjeldahl Nitrogen (mg/l)
2/8/2010	SW052	12.54	8.09		7.86		28.06			43945				
3/29/2010	SW052	10.1	7.73		9.56		27.92			43581				
4/14/2010	SW052	8.99	7.78		13.06		28.68			44429				
5/12/2010	SW052	9.7	7.95		14.36		29.23			45148				
6/28/2010	SW052	11.39	8.03		18.15		28.95			44697				
7/16/2010	SW052	9.025	7.86		21.315		29.835			45937.5				
8/24/2010	SW052	9.99	8.14		20.69		32.03			48944				
9/6/2010	SW052	9.66	8.08		18.17		31.5			48218				
10/27/2010	SW052	9.73	7.42		10.77		22.04			35100				
11/15/2010	SW052	11.72	7.86		7.42		27.33			42836				
12/8/2010	SW052	10.99	7.74		5.73		27.28			43096				
1/14/2010	SW053	10.255	7.47		7.64		25.08			39699				
2/16/2010	SW053	10.085	6.82		8.385		3.525			6449.5				
3/10/2010	SW053	11.475	7.86		6.915		27.285			42953				
4/27/2010	SW053	10.35	7.18		16.36		7.25			12586				
5/25/2010	SW053	6.93	7.76		19.19		25.65			40083				
6/22/2010	SW053	8.5	7.25		22.47		9.21			15710				
7/29/2010	SW053	6.74	7.68		22.36		29.445			45420				
8/25/2010	SW053	9.25	8.07		22.97		31.01			47587				
9/9/2010	SW053	10.435	7.83		19.125		28.98			44747				
10/26/2010	SW053	9.87	7.59		7.8		27.9			43713				
11/23/2010	SW053	17.89	6.56		-1.4		25.3			41532				
1/13/2010	SW055	4.7	6.5		8.81		5.2			9903				
2/8/2010	SW055	2.57	6.21		7.79		13.07			21730				
3/29/2010	SW055	8.63	6.82		9.13		13.91			23077				
4/14/2010	SW055	8.82	6.64		12.39		14.5			23869				
5/12/2010	SW055	6.11	6.91		14.5		20.15			32209				
6/28/2010	SW055	4.96	7.04		17.34		20.34			32476				
7/16/2010	SW055	6.54	7.16		20.42		24.12			37913				
8/24/2010	SW055	11	7.91		19.5		27.87			43188				
9/8/2010	SW055	7.66	7.46		17.49		28.12			43545				
10/27/2010	SW055	10.91	7.94		10.22		28.66			44569				
11/15/2010	SW055	9.3	6.86		9.81		9.57			16931				
12/8/2010	SW055	8.47	6.95		7.8		20			32272				
1/13/2010	SW056	7.21	7.47		8.05		0.55			1113				
2/8/2010	SW056	8.13	7.51		7.23		1.36			2628				
3/29/2010	SW056	10.86	7.5		9.86		5.7			10082				
4/14/2010	SW056	9.53	7.44		15.48		5.69			10033				
5/12/2010	SW056	7.35	7.44		16.13		5.88			16361				
6/28/2010	SW056	8.99	7.58		18.68		17.31			28047				
7/16/2010	SW056	12.7	7.76		22.3		26.59			41430				
8/24/2010	SW056	18.88	8.32		22.58		31.025			47596.5				
9/6/2010	SW056	23.11	8.3		21.09		30.22			46470				
10/27/2010	SW056	8.9	7.24		12.56		9.87			16700				
11/15/2010	SW056	9.86	7.56		9.44		4.41			7936				
12/8/2010	SW056	10.77	7.65		7.21		7.8			13574				

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Run Date	Site Number	Oxygen - Dissolved Field (mg/l)	pH - Field (pH units)	pH - Lab (pH units)	pH - Sample Temperature (deg C)	Pheophytin (ug/l)	Salinity (ppt)	Secchi Depth (cm)	Silicon (mg/l)	Specific Conductivity - Field (uS/cm)	Sulfate (mg/l)	Sulfide (mg/l)	Tin (mg/l)	Total Kjeldahl Nitrogen (mg/l)
1/14/2010	SW058	9.36	7.02		7.59		0.4			811				
2/16/2010	SW058	5.35	6.81		10.07		1.18			2282				
3/10/2010	SW058	6.66	6.91		9.96		1.86			3550				
10/26/2010	SW058	0.92	10.77		6.81		3.38			6244				
11/23/2010	SW058	6.31	7		7		2.42			4210				
1/13/2010	SW059	4.82	6.8		7.46		0.13			280				
2/8/2010	SW059	7.56	7.095		7.9		0.82			1612.5				
3/29/2010	SW059	9.75	7.205		9.28		0.62			1232				
4/14/2010	SW059	9.095	7.09		11.08		0.93			1829				
5/12/2010	SW059	7.26	6.955		13.305		1.08			2100.5				
6/28/2010	SW059	5.12	7.4		15.66		1.27			2445				
7/16/2010	SW059	14.63	8.02		21.26		2.26			4238				
8/24/2010	SW059	6.09	8.06		15.91		16.56			26918				
9/8/2010	SW059	6.85	7.7		15.64		21.7			34461				
10/27/2010	SW059	6.35	7.175		9.58		0.8			1571				
11/15/2010	SW059	7.615	7.005		8.755		0.95			1867				
1/28/2010	SW059	8.2	7.18		5.87		0.74			1474.5				
1/13/2010	SW072	8.84	5.955		6.695		0.03			58				
2/8/2010	SW072	0.92	6.71		7.05		0.11			227				
3/29/2010	SW072	8.11	7.17		9.94		0.12			241				
4/14/2010	SW072	2.15	6.91		11.55		0.11			231				
5/12/2010	SW072	4.38	6.9		17.14		0.12			260				
6/28/2010	SW072	2.66	6.82		16.95		0.13			271				
7/16/2010	SW072	2.9	6.93		22.95		0.15			314				
8/24/2010	SW072	7.19	7.13		24.4		0.16			344				
9/8/2010	SW072	5.12	6.96		20.09		0.16			331				
10/27/2010	SW072	0.62	6.61		9		0.16			325				
11/15/2010	SW072	5.76	7.11		8.09		0.16			333				
1/27/2010	SW118	3.12	6.64		6.02		0.16			325				
2/8/2010	SW118	12.49	7.48		5.29		0.06			125				
2/16/2010	SW118	12.51	7.04		7.17		0.06			135				
2/16/2010	SW118	12.66	7.49		6.77		0.05			102				
3/10/2010	SW118	13.1	7.54		5.9		0.04			86				
3/10/2010	SW118	12.89	7.61		6.44		0.06			136				
3/24/2010	SW118	11.92	7.75		8.9		0.05			114				
3/29/2010	SW118	12.02	7.09		7.52		0.04			95				
4/14/2010	SW118	12.07	7.15		9.34		0.05			110				
4/27/2010	SW118	11.8	7.26		10.455		0.05			106.5				
4/28/2010	SW118	11.61	7.67		9.37		0.04			87				
5/12/2010	SW118	11.15	7.33		12.6		0.05			103				
5/25/2010	SW118	11.53	7.55		11.76		0.05			98				
5/26/2010	SW118	11.21	7.7		10.97		0.05			99				
6/22/2010	SW118	11.835	7.46		12.17		0.04			83				
6/28/2010	SW118	11.7	7.4		10.83		0.03			75				
6/29/2010	SW118	12.03	7.52		11.78		0.03			71				
7/16/2010	SW118	11.2	8.32		15.83		0.04			81				
7/20/2010	SW118	11.28	8.04		15.53		0.04			84				
7/29/2010	SW118	11.51	7.95		16.47		0.04			77				
8/24/2010	SW118	10.43	7.54		17.08		0.05			113				

Table A.3 2010 Selected Water Quality Results

Run Date	Site Number	Oxygen - Dissolved Field (mg/l)	pH - Field (pH units)	pH - Lab (pH units)	pH - Sample Temperature (deg C)	Pheophytin (ug/l)	Salinity (ppt)	Secchi Depth (cm)	Silicon (mg/l)	Specific Conductivity - Field (uS/cm)	Sulfate (mg/l)	Sulfide (mg/l)	Tin (mg/l)	Total Kjeldahl Nitrogen (mg/l)
8/25/2010	SW118	10.24	7.95		18.04		0.05			110				
8/31/2010	SW118	10.5	7.52		13.89		0.05			117				
9/6/2010	SW118	10.49	7.56		15.13		0.05			114				
9/9/2010	SW118	10.34	7.56		15.865		0.05			115				
9/14/2010	SW118	10.73	7.43		13.64		0.04			88.5				
10/13/2010	SW118	11.2	7.66		10.39		0.05			103				
10/26/2010	SW118	12.05	7.24		7.745		0.03			63				
10/27/2010	SW118	12.03	7.35		8.58		0.04			95				
11/10/2010	SW118	12.945	7.64		6.625		0.04			90				
11/15/2010	SW118	13.69	7.11		7.82		0.04			96				
11/23/2010	SW118													
12/8/2010	SW118	12.37	7.3		6.34		0.06			117				

Table A.4 2010 Selected Water Quality Results

Run Date	Site Number	Total Nitrogen (mg/l)	Total Organic Carbon (mg/l)	Total Phosphorus (mg/l)	Total Suspended Solids (mg/l)	Total Volatile Suspended Solids (mg/l)	Turbidity (NTU)	Water Depth (ft)	Water Level (VG) (ft)	Water Temperature - In Situ (deg C)	Water Temperature - pH Lab (deg C)	Zinc (mg/l)
1/25/2010	DH038							6.2		7.21		
3/3/2010	DH038							3.95		8.685		
5/13/2010	DH038							4.265		13.26		
7/12/2010	DH038							6.56		13.95		
9/27/2010	DH038							5.17		13.14		
11/8/2010	DH038							5.906		9.295		
12/14/2010	DH038							5.5		7.44		
1/25/2010	DH039							7.4		7.355		
3/3/2010	DH039							5.8		8.46		
5/13/2010	DH039							6.234		11.95		
7/12/2010	DH039							8.53		13.36		
9/27/2010	DH039							7.66		12.31		
11/8/2010	DH039							7.546		9.38		
12/14/2010	DH039							8.7		7.48		
1/25/2010	DH040							7		7.37		
3/3/2010	DH040							4.6		8.26		
5/13/2010	DH040							5.577		11.93		
7/12/2010	DH040							8.2		13.435		
9/27/2010	DH040							6.562		12.51		
11/8/2010	DH040							7.218		9.42		
12/14/2010	DH040							7.9		7.62		
1/25/2010	DH041							6		7.45		
3/3/2010	DH041							4.5		8.28		
5/13/2010	DH041							4.921		12.19		
7/12/2010	DH041							7.167		13.57		
9/27/2010	DH041							5.66		12.68		
11/8/2010	DH041							6.234		9.35		
1/25/2010	DH042							6.4		7.11		
3/3/2010	DH042							4.8		8.82		
5/13/2010	DH042							5.249		15.85		
7/12/2010	DH042							8		15.78		
9/27/2010	DH042							6.166		13.59		
11/8/2010	DH042							6.89		8.99		
1/25/2010	DH043							7.1		7.38		
3/3/2010	DH043							4.8		8.48		
5/13/2010	DH043							6.234		13.78		
7/12/2010	DH043							8.86		14.45		
9/27/2010	DH043							7.546		14.14		
11/8/2010	DH043							9.186		9.35		
1/25/2010	DH044							1		6.6		
3/3/2010	DH044						2.03	0.8333		9.51		
5/13/2010	DH044						7.455	0.667		19.52		
7/12/2010	DH044						3.92	0.58		20.59		
9/27/2010	DH044						3.97	0.667		18.71		

Table A.4 2010 Selected Water Quality Results

Run Date	Site Number	Total Nitrogen (mg/l)	Total Organic Carbon (mg/l)	Total Phosphorus (mg/l)	Total Suspended Solids (mg/l)	Total Volatile Suspended Solids (mg/l)	Turbidity (NTU)	Water Depth (ft)	Water Level (VG) (ft)	Water Temperature In Situ (deg C)	Water Temperature - pH Lab (deg C)	Zinc (mg/l)
12/14/2010	DH044									6.525		
1/25/2010	DH045							1		6.885		
3/3/2010	DH045						0.755	0.75		9.57		
5/13/2010	DH045						1.39	0.5		17.79		
7/12/2010	DH045						2.665	0.67		19.625		
9/27/2010	DH045						0.995	0.833		18.23		
1/18/2010	DH045						1.08	0.667		9.85		
12/14/2010	DH045							0.833		6.515		
1/27/2010	DH048									9		
3/24/2010	DH048									12		
5/26/2010	DH048									16		
7/20/2010	DH048									13		
9/14/2010	DH048									10		
11/16/2010	DH048									7		
1/27/2010	DH049									9		
3/24/2010	DH049									14		
5/26/2010	DH049									19		
7/20/2010	DH049									15		
9/14/2010	DH049									10		
11/16/2010	DH049							8		7.69		
12/14/2010	DH049									6		
1/27/2010	DH050									9		
3/24/2010	DH050									14		
5/26/2010	DH050									20		
7/20/2010	DH050									15		
9/14/2010	DH050									9		
11/16/2010	DH050									5		
1/27/2010	DH051									8		
3/24/2010	DH051									14		
5/26/2010	DH051									20		
7/20/2010	DH051									15		
9/14/2010	DH051									9		
11/16/2010	DH051									6		
1/27/2010	DH052									8		
3/24/2010	DH052									14		
5/26/2010	DH052									20		
7/20/2010	DH052									15		
9/14/2010	DH052									9		
11/16/2010	DH052									6.44		
12/14/2010	DH052							5		7		
1/27/2010	DH053									8		
3/24/2010	DH053									14		
5/26/2010	DH053									19		
7/20/2010	DH053											

Table A.4 2010 Selected Water Quality Results

Run Date	Site Number	Total Nitrogen (mg/l)	Total Organic Carbon (mg/l)	Total Phosphorus (mg/l)	Total Suspended Solids (mg/l)	Total Volatile Suspended Solids (mg/l)	Turbidity (NTU)	Water Depth (ft)	Water Level (VG) (ft)	Water Temperature In Situ (deg C)	Water Temperature - pH Lab (deg C)	Zinc (mg/l)
9/14/2010	DH053									15		
11/16/2010	DH053									9		
1/27/2010	DH054									7		
3/24/2010	DH054									9		
5/26/2010	DH054									14		
7/20/2010	DH054									19		
9/14/2010	DH054									15		
11/16/2010	DH054									10		
1/27/2010	DH055									7		
3/24/2010	DH055									9		
5/26/2010	DH055									14		
7/20/2010	DH055									19		
9/14/2010	DH055									15		
11/16/2010	DH055									10		
1/27/2010	DH057									6		
3/24/2010	DH057									8		
5/26/2010	DH057									14		
7/20/2010	DH057									19		
9/14/2010	DH057									15		
11/16/2010	DH057									9		
12/14/2010	DH057							7		6.78		
1/27/2010	DH058									6		
3/24/2010	DH058									8		
5/26/2010	DH058									14		
7/20/2010	DH058									19		
9/14/2010	DH058									15		
11/16/2010	DH058									9		
1/27/2010	DH271									6		
3/24/2010	DH271									8		
5/26/2010	DH271									14		
7/20/2010	DH271									20		
9/14/2010	DH271									15		
12/14/2010	DH271							10		6.31		
1/27/2010	DH272									6		
3/24/2010	DH272									9		
5/26/2010	DH272									14		
7/20/2010	DH272									20		
9/14/2010	DH272									15		
11/16/2010	DH272									9		
1/25/2010	DH285							4.8		5.49		
3/3/2010	DH285							2.9		9.11		
5/13/2010	DH285							3.937		13.75		
7/12/2010	DH285							5.9		15.17		
9/27/2010	DH285							4.33		14.04		

Table A.4 2010 Selected Water Quality Results

Run Date	Site Number	Total Nitrogen (mg/l)	Total Organic Carbon (mg/l)	Total Phosphorus (mg/l)	Total Suspended Solids (mg/l)	Total Volatile Suspended Solids (mg/l)	Turbidity (NTU)	Water Depth (ft)	Water Level (VG) (ft)	Water Temperature - In Situ (deg C)	Water Temperature - pH Lab (deg C)	Zinc (mg/l)
11/8/2010	DH285							4.921		9.12		
12/14/2010	DH285							5.4		7.04		
1/25/2010	DH286							2.7		6.72		
3/3/2010	DH286							1.7		9.23		
5/13/2010	DH286							1.64		18.22		
7/12/2010	DH286							3.28		16.92		
9/27/2010	DH286							2.625		16.05		
11/8/2010	DH286							2.953		8.94		
12/14/2010	DH286							3.8		6.4		
1/25/2010	DH287							6.4		6.01		
3/3/2010	DH287							4		8.95		
5/13/2010	DH287							5.249		12.64		
7/12/2010	DH287							6.5		13.31		
9/27/2010	DH287							5.5		12.26		
11/8/2010	DH287							5.906		9.24		
12/14/2010	DH287							6.7		7.37		
1/25/2010	DH288							3.3		7.1		
3/3/2010	DH288							2.7		8.92		
5/13/2010	DH288							2.625		14.46		
7/12/2010	DH288							3.5		14.83		
9/27/2010	DH288							2.625		13.51		
11/8/2010	DH288							3.609		9.14		
12/14/2010	DH288							3.8		7.18		
1/26/2010	SW001							11.6		7.04		0.045
2/9/2010	SW001							7.8		7.7		
3/15/2010	SW001							8.3		7.62		
4/6/2010	SW001							8.3		9.17		
5/7/2010	SW001									13.035		
6/8/2010	SW001							9.3		16.4		
7/19/2010	SW001							13.1		17.36		
8/17/2010	SW001							12.9		17.64		
9/7/2010	SW001									14.82		
10/12/2010	SW001							14.436		12.14		
11/9/2010	SW001									8.89		
1/26/2010	SW002	0.63	0.61	0.33	2.8	1.5		5.8		7.05		6.2
2/9/2010	SW002							5.7		7.74		
3/15/2010	SW002							2.5		8.53		
4/6/2010	SW002							4		8.74		
5/7/2010	SW002							3.6		12.75		
6/8/2010	SW002							3		14.33		
7/19/2010	SW002							4.6		14.06		
8/17/2010	SW002							5.1		14.75		
9/7/2010	SW002							5.1		12.96		
10/12/2010	SW002							6.562		11.11		

Table A.4 2010 Selected Water Quality Results

Run Date	Site Number	Total Nitrogen (mg/l)	Total Organic Carbon (mg/l)	Total Phosphorus (mg/l)	Total Suspended Solids (mg/l)	Total Volatile Suspended Solids (mg/l)	Turbidity (NTU)	Water Depth (ft)	Water Level (VG) (ft)	Water Temperature - In Situ (deg C)	Water Temperature - pH Lab (deg C)	Zinc (mg/l)
11/9/2010	SW002										9.2	
1/14/2010	SW003		14.4	0.49	22	5.4	45.1	2.5	1	7.68	7.1	
2/16/2010	SW003						127	3	0.5	7.52		
3/10/2010	SW003						9.42	1.75	0	5.98		
4/27/2010	SW003						8.41	1.75	-0.5	11.36		
5/25/2010	SW003						6.77	2	-0.5	14.98		
6/22/2010	SW003						8.28	1.5	-1	13.99		
7/29/2010	SW003						4.79	2.5		21.7		
8/25/2010	SW003						4.75	1.25	-1.5	18.53		
9/9/2010	SW003						4.71	1.5	-1	16.89		
10/26/2010	SW003						9.79	3	0.5	9.71		
11/23/2010	SW003						8.35	1.5	-0.25	-0.27		
1/13/2010	SW004						203		4	5.9		
1/14/2010	SW004						117	3		6.22		
1/26/2010	SW006	0.75	0.75	0.26	5.3	1.5		7.5		6.92	7.1	
2/9/2010	SW006							14.6		7.67		
3/15/2010	SW006							10.5		8.36		
4/6/2010	SW006							6.9		9.09		
5/7/2010	SW006									12		
6/8/2010	SW006							10		15.485		
7/19/2010	SW006							6.1		18.1		
8/17/2010	SW006							9		18.87		
9/7/2010	SW006							11.483		15.43		
10/12/2010	SW006							14.108		12.72		
11/9/2010	SW006									8.77		
1/27/2010	SW007						7.996666667	2		5.43		
2/17/2010	SW007						39.65	2.25		5.935		
3/24/2010	SW007						4.445	0.833	-4.25	9.43		
4/28/2010	SW007						12.5	3.5	-2.5	9.97		
5/26/2010	SW007						5.72	1.5	-3.5	11.57		
6/29/2010	SW007						20.8	2.75	-1.5	11.805		
7/20/2010	SW007						9.3	1	-3	16.06		
8/31/2010	SW007						10.1	0.667	-4.5	13.765		
9/14/2010	SW007						24.9	1.5	-3.25	13.58		
10/13/2010	SW007						20.1	1.5		10.545		
11/10/2010	SW007						18.9		-2	6.77		
1/14/2010	SW008						65.4	2	0	7.25		
2/16/2010	SW008						65.8	0.833	-4	8.56		
3/10/2010	SW008						21.4	1.5	-0.75	7.26		
4/27/2010	SW008						20.1	1	-5	14.81		
5/25/2010	SW008						16.2	0.667	-4	18.74		
6/22/2010	SW008						18.8	1	-0.5	19.07		
7/29/2010	SW008						9.53	1.5	-3	22.82		
8/25/2010	SW008						11.3	0.833	-4	22.89		

Table A.4 2010 Selected Water Quality Results

Run Date	Site Number	Total Nitrogen (mg/l)	Total Organic Carbon (mg/l)	Total Phosphorus (mg/l)	Total Suspended Solids (mg/l)	Total Volatile Suspended Solids (mg/l)	Turbidity (NTU)	Water Depth (ft)	Water Level (VG) (ft)	Water Temperature - In Situ (deg C)	Water Temperature - pH Lab (deg C)	Zinc (mg/l)
9/9/2010	SW008						21.4	1	-2.75		18.7	
10/26/2010	SW008						7.18	1	0		8.44	
1/14/2010	SW009		5.38	0.35	23	3	50.2	2	-0.5		6.87	7.1
2/16/2010	SW009						35	1.5	-1		8.85	
3/10/2010	SW009						16.2	1.25	-1.5		7.21	
4/27/2010	SW009						15.1	1.75	-2.5		14.04	
5/25/2010	SW009						6.445	1.5	-3		13.525	
6/22/2010	SW009						9.66	1	-2.5		16.2	
7/29/2010	SW009						15.9	1.25	-3		20.68	
8/25/2010	SW009						12.9	1.25	-2.5		17.57	
9/9/2010	SW009						21.7	1.5	-2.5		18.66	
10/26/2010	SW009						12.3	1.5	-1.75		8.52	
1/14/2010	SW010						11.4	3	1		7.65	
2/16/2010	SW010						25.4	2.5	-1		9.04	
3/10/2010	SW010						23.5	1.5	-0.5		7.08	
5/25/2010	SW010						6.38	2	-2		16.92	
6/22/2010	SW010						17	2	-1		17.54	
7/29/2010	SW010						10.3	2	-1.5		22.43	
8/25/2010	SW010						80.5	2	-1.5		22.92	
9/9/2010	SW010						38.4	1	-1		20.1	
10/26/2010	SW010						9.03	3	0.5		9.24	
1/14/2010	SW011						7.4	1.5			7.45	
2/16/2010	SW011						61.5	3	0.5		7.92	
3/10/2010	SW011						4.52	0.83333	-1.75		7.6	
4/27/2010	SW011						4.635	1	-2		11.305	
5/25/2010	SW011						5.2	1	-2		11.72	
6/22/2010	SW011						5.17	1.25	-2		14.085	
7/29/2010	SW011						8.22	0.83			15.6	
8/25/2010	SW011						10.55	0.667	-3.5		14.5	
9/9/2010	SW011						18.4	1.25			12.88	
10/26/2010	SW011						4.48	1	-1.5		9.09	
1/14/2010	SW012						4.3	0.667	-0.75		-0.17	
2/16/2010	SW012						2.715	2			7.77	
3/10/2010	SW012						5.92	2.75	-1		8.31	
4/27/2010	SW012						6.925	0.9	-0.625		6.61	
5/25/2010	SW012						2.67	1	-0.5		12.78	
6/22/2010	SW012						11.1	0.417	-2		13.56	
7/29/2010	SW012						5.26	1.5	-1		16.11	
8/25/2010	SW012						10.3	0.5	-2		23.12	
9/9/2010	SW012						24.9	0.375	-2.75		18.32	
10/26/2010	SW012						22.3	0.667	-2		22.3	
11/23/2010	SW012						2.86	1.25	-1.5		9.51	
1/14/2010	SW013						12.5	1.5	-2		0.36	
							42.7	3	2		7.77	

Table A.4 2010 Selected Water Quality Results

Run Date	Site Number	Total Nitrogen (mg/l)	Total Organic Carbon (mg/l)	Total Phosphorus (mg/l)	Total Suspended Solids (mg/l)	Total Volatile Suspended Solids (mg/l)	Turbidity (NTU)	Water Depth (ft)	Water Level (VG) (ft)	Water Temperature In Situ (deg C)	Water Temperature - pH Lab (deg C)	Zinc (mg/l)
2/16/2010	SW013						62.9	4.5	1		9.08	
3/10/2010	SW013						36.2	2.5	-0.5		7.28	
4/27/2010	SW013						17.9	3	-0.167		13.26	
5/25/2010	SW013						22	3	-2		16.76	
6/22/2010	SW013						17.5	2.25	-2		19.96	
7/29/2010	SW013						15.2	2	-1.5		20.68	
8/25/2010	SW013						71.3	1.5	-3		19.46	
9/9/2010	SW013						46.4	1.25	-3		17.69	
10/26/2010	SW013						25.2	5	1		9.53	
1/14/2010	SW014						10.8	1.25	1		7.34	6.7
2/16/2010	SW014						22.2	1			7.99	
3/10/2010	SW014						11.5	1			5.14	
4/27/2010	SW014						10.1	0.917			10.59	
5/25/2010	SW014						5.32	0.833			13.57	
6/22/2010	SW014						6.66	1			14.07	
9/9/2010	SW014						5.79	1			14.32	
10/26/2010	SW014						7.73	0.917			9.04	
11/23/2010	SW014						12.35	1			0.35	
1/13/2010	SW015		16.5	0.62	22	9.6	35.1	3.5	1.5		7.68	7.2
2/8/2010	SW015						22.4	3	-0.5		7.83	
3/29/2010	SW015						28.7	4	-0.167		8.91	
4/14/2010	SW015						28.5	2.5	-0.5		12.7	
5/12/2010	SW015		14.4	0.16	7.8	2	8.69	3.25	0		16.5	8
6/28/2010	SW015						15.95	3	-1		16.655	
7/16/2010	SW015						24.5	2.75	-1		17.3	
8/24/2010	SW015						15.7	2	-2.5		16.04	
9/8/2010	SW015						6.065	2.5	-2		13.955	
10/27/2010	SW015						22.1	3	0.5		9.72	
11/15/2010	SW015						14.3	4	-1.5		8.99	
12/8/2010	SW015						19.9	3	-0.5		6.31	
1/13/2010	SW016						4.995	2.5	0.5		8.11	
2/8/2010	SW016						19.3	2.25	-0.5		8.17	
3/29/2010	SW016						9.04	2.5	-0.5		9.64	
4/14/2010	SW016						3.37	0.833			11.54	
5/12/2010	SW016						26.7	0.667			12.96	
6/28/2010	SW016						16.7	2	-1		16.14	
7/16/2010	SW016						26.9	1	-1.5		19.79	
10/27/2010	SW016						16.6	1.25	-0.25		10.83	
11/15/2010	SW016						33.4	2.5	-2.5		9.77	
12/8/2010	SW016						28	2	-2		8.13	
1/13/2010	SW017						12	2.5	0.5		8.4	
2/8/2010	SW017						10.2	3.5	0.5		7.94	
3/29/2010	SW017						27.8	3	0.5		10.12	
4/14/2010	SW017						9.33	2.5			11.65	

Table A.4 2010 Selected Water Quality Results

Run Date	Site Number	Total Nitrogen (mg/l)	Total Organic Carbon (mg/l)	Total Phosphorus (mg/l)	Total Suspended Solids (mg/l)	Total Volatile Suspended Solids (mg/l)	Turbidity (NTU)	Water Depth (ft)	Water Level (VG) (ft)	Water Temperature - In Situ (deg C)	Water Temperature - pH Lab (deg C)	Zinc (mg/l)
5/12/2010	SW017						8.45	2.5			13.18	
6/28/2010	SW017						32.3	3	-0.5		16.39	
7/16/2010	SW017						48.4	1.25	-0.5		21.34	
10/27/2010	SW017						27.7	2.5	0.5		11	
11/15/2010	SW017						18	3	0		9.22	
12/8/2010	SW017						15	3	0		7.61	
1/26/2010	SW019							17.7			7.28	
2/9/2010	SW019							16.2			7.74	
3/15/2010	SW019							10.1			7.88	
4/6/2010	SW019							11.6			9.2	
5/7/2010	SW019										12.63	
6/8/2010	SW019							9			14.97	
7/19/2010	SW019							13.5			15.59	
8/17/2010	SW019							13.9			16.05	
9/7/2010	SW019										14.31	
10/12/2010	SW019							16.732			12.05	
11/9/2010	SW019										9.13	
1/26/2010	SW022							7.2			7.47	
2/9/2010	SW022							6.4			7.08	
3/15/2010	SW022							3.5			8.46	
4/6/2010	SW022							3.75			9.57	
5/7/2010	SW022							2.95			12.39	
6/8/2010	SW022							1.969			15.83	
7/19/2010	SW022							14.44			15.11	
8/17/2010	SW022							4.8			15.1	
9/7/2010	SW022							3.9			12.525	
10/12/2010	SW022							6.89			11.09	
11/9/2010	SW022										9.1	
1/26/2010	SW023							8.3			4.84	
2/9/2010	SW023							7.4			6.33	
3/15/2010	SW023							4.1			8.755	
4/6/2010	SW023							5.2			8.955	
5/7/2010	SW023										10.06	
6/8/2010	SW023							6			15.72	
7/19/2010	SW023							7			18.765	
8/17/2010	SW023							5.7			19.28	
9/7/2010	SW023							5.249			14.97	
10/12/2010	SW023							7.874			12.83	
11/9/2010	SW023										8.33	
2/9/2010	SW025						21.25	0.333			6.27	
3/15/2010	SW025						6.53	0.25			9.6	
4/6/2010	SW025						33.4	0.333			8.67	
1/26/2010	SW026						7.23	2	2		5.43	
2/9/2010	SW026						4.625	0.6665	-1		7.155	

Table A.4 2010 Selected Water Quality Results

Run Date	Site Number	Total Nitrogen (mg/l)	Total Organic Carbon (mg/l)	Total Phosphorus (mg/l)	Total Suspended Solids (mg/l)	Total Volatile Suspended Solids (mg/l)	Turbidity (NTU)	Water Depth (ft)	Water Level (VG) (ft)	Water Temperature - In Situ (deg C)	Water Temperature - pH Lab (deg C)	Zinc (mg/l)
3/15/2010	SW026						7.99	0.5	-0.5		13.125	
4/6/2010	SW026						7.78	0.333	-0.5		9.745	
5/7/2010	SW026						26.6	0.167			-0.5	
6/8/2010	SW026						28.15	0.625	-2		21.795	
9/7/2010	SW026						11.3	0.292			19.6	
11/9/2010	SW026						37	1			8.56	
1/26/2010	SW027						4.05	1.5	1		5.67	
2/9/2010	SW027						5.696666667	0.542	-2.5		7.9	
3/15/2010	SW027						7.74	0.646665	-3		11.52	
4/6/2010	SW027						19.75	0.4585			9.18	
5/7/2010	SW027						72.74	0.54			13.775	
6/8/2010	SW027						15.49333333	0.416333	-2.5		17.41	
1/26/2010	SW028						6.77	1.75	0.5		3.82	
2/9/2010	SW028						16.1	0.8335	-1.5		9.23	
3/15/2010	SW028						15.71666667	0.944433	-4		14.59	
4/6/2010	SW028						11.815	1.0415	-1.5		9.24	
5/7/2010	SW028						7.49	1			16.95	
6/8/2010	SW028						23.3	0.9585	-2.5		21.48	
7/19/2010	SW028						8.88	0.92			23.12	
8/17/2010	SW028						10.7	1.083	-3		25.37	
9/7/2010	SW028						5.6	0.667			18.53	
10/12/2010	SW028						17.85	0.9165	-2.75		14.04	
11/9/2010	SW028						8.9	1.25			8.67	
1/19/2010	SW028						10.6	0.5	-1		3.51	
2/17/2010	SW029						11.2	0.833	-0.667		5.28	
3/24/2010	SW029						12.5	0.417	-1		7.19	
4/28/2010	SW029						20.3	0.75			9.63	
5/26/2010	SW029						51	0.417	-1.5		10.95	
6/29/2010	SW029						12.9	0.5			12.19	
10/13/2010	SW029						9.69	0.5			9.7	
11/10/2010	SW029						5.49	0.667	-1.5		6.99	
1/27/2010	SW030						5.63	2.5			5.41	
2/17/2010	SW030						6.55	0.5			11.56	
3/24/2010	SW030						9.19	0.917			10.75	
4/28/2010	SW030						58.35	1			17.955	
5/26/2010	SW030						1.88	0.667			14.47	
6/29/2010	SW030						69.45	0.875			19.42	
7/20/2010	SW030						8.64	2			21.23	
8/31/2010	SW030						53.2	1			14.47	
9/14/2010	SW030						3.61	2			15.43	
10/13/2010	SW030						5.16	2.5			13.48	
11/10/2010	SW030						6.16	1.5			9.36	
1/27/2010	SW031						11.7	0.167	-0.5		4.8	
2/17/2010	SW031						11.3	0.25			7.14	

Table A.4 2010 Selected Water Quality Results

Run Date	Site Number	Total Nitrogen (mg/l)	Total Organic Carbon (mg/l)	Total Phosphorus (mg/l)	Total Suspended Solids (mg/l)	Total Volatile Suspended Solids (mg/l)	Turbidity (NTU)	Water Depth (ft)	Water Level (VG) (ft)	Water Temperature - In Situ (deg C)	Water Temperature - pH Lab (deg C)	Zinc (mg/l)
3/24/2010	SW031						11.75	0.667		10.26		
4/28/2010	SW031						11.5	0.292		12.23		
6/29/2010	SW031						8.38	0.29		16.19		
1/27/2010	SW032						6.73	2		4.58		
2/17/2010	SW032						3.29	2		9.03		
3/24/2010	SW032						1.21	2.5		9.87		
4/28/2010	SW032						23.9	2		14.32		
5/26/2010	SW032						4.62	1.75		13.965		
6/29/2010	SW032						10.6	1		20.4		
7/20/2010	SW032						7.95	2.5		20.33		
8/31/2010	SW032						44.4	2		14.24		
9/14/2010	SW032						7.05	2		15.06		
10/13/2010	SW032						7.95	1.5		12.53		
11/10/2010	SW032						7.89	1		8.53		
1/27/2010	SW033						18.2	0.333	-0.5	4.64		
2/17/2010	SW033						19.15	0.25		6.875		
3/24/2010	SW033						15.8	0.333		9.265		
4/28/2010	SW033						13.85	0.208		11.705		
6/29/2010	SW033						13.1	0.25		15.85		
1/27/2010	SW034						5.43	3.5		4.18		
2/17/2010	SW034						5.12	0.917		9.22		
3/24/2010	SW034						3.91	2		9.48		
4/28/2010	SW034						10.6	1.25		13.5		
5/26/2010	SW034						3.8	1		13.7		
6/29/2010	SW034						33.9	0.833		17.14		
7/20/2010	SW034						7.57	2.5		19.005		
8/31/2010	SW034						45.2	1		14.24		
9/14/2010	SW034						5.23	2		15.21		
10/13/2010	SW034						7.59	2		12.75		
11/10/2010	SW034						7.29	1.25		9.05		
1/27/2010	SW035						10.1	0.5	-0.5	4.02		
2/17/2010	SW035						9.41	0.333		6.56		
4/28/2010	SW035						4.99	0.333		12.05		
1/27/2010	SW036						4.9	2.75		2.86		
2/17/2010	SW036						5.58	2.5		8		
3/24/2010	SW036						3.35	1.5		9.42		
4/28/2010	SW036						10.94	1		12.33		
5/26/2010	SW036						1.95	1.5		13.16		
6/29/2010	SW036						52.7	0.833		17.29		
7/20/2010	SW036						8.84	2.5		19.38		
8/31/2010	SW036						60.6	1.5		14.05		
9/14/2010	SW036						3.14	2.5		14.48		
10/13/2010	SW036						10.1	2.5		12.32		
11/10/2010	SW036						9.98	2		9.19		

Table A.4 2010 Selected Water Quality Results

Run Date	Site Number	Total Nitrogen (mg/l)	Total Organic Carbon (mg/l)	Total Phosphorus (mg/l)	Total Suspended Solids (mg/l)	Total Volatile Suspended Solids (mg/l)	Turbidity (NTU)	Water Depth (ft)	Water Level (VG) (ft)	Water Temperature - In Situ (deg C)	Water Temperature - pH Lab (deg C)	Zinc (mg/l)
2/17/2010	SW037						2.44	0.208			8.58	
3/24/2010	SW037						1.53	0.208			10	
1/27/2010	SW038						4.83	3.5			2.53	
2/17/2010	SW038						8.78	2.5			7.68	
3/24/2010	SW038						3.7	2			9.49	
4/28/2010	SW038						5.14	0.5			14.17	
5/26/2010	SW038						4.4	1			12.9	
6/29/2010	SW038						7.39	0.833			15.91	
7/20/2010	SW038						7.23	2.5			18.5	
8/31/2010	SW038						5.1	2			14.25	
9/14/2010	SW038						3.28	2			14.38	
10/13/2010	SW038						7.91	2.25			11.53	
11/10/2010	SW038						8.7	1.5			8.32	
1/27/2010	SW039						1.69	1.5			7.5	
2/17/2010	SW039						7.93	2.5			8.67	
3/24/2010	SW039						3.64	2			10.19	
4/28/2010	SW039						18.7				12.39	
5/26/2010	SW039						12.4	2.5			12.19	
6/29/2010	SW039						7.33	1.25			14.31	
7/20/2010	SW039						7.69	2.5			17.47	
8/31/2010	SW039						30.4	1.75			14.15	
9/14/2010	SW039						3.18	1.5			13.8	
10/13/2010	SW039						5.44	2			11.46	
11/10/2010	SW039						5	1			9.69	
1/13/2010	SW051						67.4	0.667	1		8.02	
1/14/2010	SW051						13.1	1.25	0		7.59	
2/8/2010	SW051						6.26	1	-0.333		8.1	
2/16/2010	SW051						12	0.583	-4		8.29	
3/10/2010	SW051						16.2	0.667	-2.5		6.59	
3/29/2010	SW051						41.6	1	-5		9.47	
4/14/2010	SW051						9.78	0.833	-8.5		15.76	
4/27/2010	SW051						18.3	0.917	-7		14.68	
5/12/2010	SW051						7.45	0.833	-7		16.68	
5/25/2010	SW051						7.83	0.5	-5		18.38	
6/22/2010	SW051						6.44	0.67	-7		20.37	
6/28/2010	SW051						10.1	0.67	-5		19.58	
7/16/2010	SW051						14.3	0.67	-4.5		22.38	
7/29/2010	SW051						21.8	0.67	-6		22.58	
8/24/2010	SW051						21.1	0.833	-6.5		23.02	
8/25/2010	SW051						9.12	0.75	-5.5		21.85	
9/8/2010	SW051						8.85	0.833	-7.5		18.79	
9/9/2010	SW051						9.92	0.833	-6		19.19	
10/26/2010	SW051						4.13	0.833	0		8.25	
10/27/2010	SW051						3.51	1.5	-0.5		9.53	
11/15/2010	SW051						10.5	0.667	0		8.67	
11/23/2010	SW051						6.44	0.5	-2		-1.58	
1/28/2010	SW051						11.9	2	2		7.39	
1/13/2010	SW052						1.15	1	1		8.48	

Table A.4 2010 Selected Water Quality Results

Run Date	Site Number	Total Nitrogen (mg/l)	Total Organic Carbon (mg/l)	Total Phosphorus (mg/l)	Total Suspended Solids (mg/l)	Total Volatile Suspended Solids (mg/l)	Turbidity (NTU)	Water Depth (ft)	Water Level (VG) (ft)	Water Temperature - In Situ (deg C)	Water Temperature - pH Lab (deg C)	Zinc (mg/l)
2/8/2010	SW052						0.45	1			7.86	
3/29/2010	SW052						15.7	0.833	-3		9.56	
4/14/2010	SW052						1.4				13.06	
5/12/2010	SW052						1.58	1			14.36	
6/28/2010	SW052						1.21	0.833			18.15	
7/16/2010	SW052						1.36	0.83			21.315	
8/24/2010	SW052						0.93	0.833			20.69	
9/8/2010	SW052						0.65	0.667			18.17	
10/27/2010	SW052						10.9	1.5	-0.5		10.77	
11/15/2010	SW052						2.61	0.833			8.57	
12/8/2010	SW052						20.8	1			5.73	
1/14/2010	SW053						22.5	2.5			7.64	
2/16/2010	SW053						61.2	3			8.385	
3/10/2010	SW053						5.06	0.75			6.915	
4/27/2010	SW053						20.8	2			16.36	
5/25/2010	SW053						17	2.5			19.19	
6/22/2010	SW053						9.36	2			22.47	
7/29/2010	SW053						5.61	2			22.36	
8/25/2010	SW053						6.44	1.5			22.97	
9/9/2010	SW053						6.555	2			19.125	
10/26/2010	SW053						14.9	1.25			7.8	
11/23/2010	SW053						6.06				-1.4	
1/13/2010	SW055						17.6	3	0.208		8.81	
2/8/2010	SW055						12.4	1.5	-0.333		7.7	
3/29/2010	SW055						7.42	1.5	-0.417		9.13	
4/14/2010	SW055						7.88	1.25	-1.5		12.39	
5/12/2010	SW055						3.67	1.5	-1		14.5	
6/28/2010	SW055						6.4	1.5	-0.5		17.34	
7/16/2010	SW055						5.14	1.25	-0.5		20.42	
8/24/2010	SW055						11.2	1	-1		19.5	
9/8/2010	SW055						3.69	1	-1.5		17.49	
10/27/2010	SW055						1.06	1			10.22	
11/15/2010	SW055						11.8	3.5	-0.25		9.81	
12/8/2010	SW055						6.24	1.5	-0.5		7.8	
1/13/2010	SW056						13.8	4	2		7.47	
2/8/2010	SW056						13	1	0		7.23	
3/29/2010	SW056						12.9	1	-0.417		9.86	
4/14/2010	SW056						26.1	0.5	-3		15.48	
5/12/2010	SW056						8.39	0.667	-1		16.13	
6/28/2010	SW056						6.57	1	-0.75		18.68	
7/16/2010	SW056						4.41	1.25	-0.5		22.3	
8/24/2010	SW056						13.5	0.667	-2		22.58	
9/8/2010	SW056						24.8	0.583	-2.5		21.09	
10/27/2010	SW056						15.6	1.5	-0.25		12.56	
11/15/2010	SW056						14	1.25	-0.5		9.44	
12/8/2010	SW056						20.7	1	0		7.21	

Table A.4 2010 Selected Water Quality Results

Run Date	Site Number	Total Nitrogen (mg/l)	Total Organic Carbon (mg/l)	Total Phosphorus (mg/l)	Total Suspended Solids (mg/l)	Total Volatile Suspended Solids (mg/l)	Turbidity (NTU)	Water Depth (ft)	Water Level (VG) (ft)	Water Temperature - In Situ (deg C)	Water Temperature - pH Lab (deg C)	Zinc (mg/l)
1/14/2010	SW058						43.4	1.75			7.59	
2/16/2010	SW058						66.7	2	0.5		10.07	
3/10/2010	SW058						58.3		-0.5		9.96	
10/26/2010	SW058						48.5	1			10.77	
11/23/2010	SW058						44.6	1			2.42	
1/13/2010	SW059						24.2	3.5	2.5		7.46	
2/8/2010	SW059						17.1	2	0		7.095	
3/29/2010	SW059						15.95	3	-0.417		9.28	
4/14/2010	SW059						17.45	2.5	-1		11.08	
5/12/2010	SW059						12.95	2	-0.25		13.305	
6/28/2010	SW059						7.83	1.75	-0.5		15.66	
7/16/2010	SW059						4.16	1.5	-0.5		21.26	
8/24/2010	SW059						6.73	1.5	-2		15.91	
9/8/2010	SW059						15.8	1.5	-1.5		15.64	
10/27/2010	SW059						5.565	2.5	0.5		9.58	
11/15/2010	SW059						7.325	2.5	-1		8.735	
12/8/2010	SW059						9.635	2.5	0.5		5.87	
1/13/2010	SW072						129	3.25	0.25		6.695	
2/8/2010	SW072						11	1	-0.333		7.05	
3/29/2010	SW072						5.52	3	-0.5		9.94	
4/14/2010	SW072						3.98	2			11.55	
5/12/2010	SW072						4.35	1			17.14	
6/28/2010	SW072						10.4	2			16.95	
7/16/2010	SW072						13		-0.5		22.95	
8/24/2010	SW072						25.4	0.833			24.4	
9/8/2010	SW072						15.7	0.833			20.09	
10/27/2010	SW072						10.6	1.25	-0.5		9	
11/15/2010	SW072						5.14	0.833			8.09	
12/8/2010	SW072						10.1	1	-0.5		6.02	
1/27/2010	SW118						9.12	1.5			5.29	
2/8/2010	SW118						6.4	0.667			7.17	
2/16/2010	SW118						24.8	0.583			6.77	
2/17/2010	SW118						34.4	0.833			5.9	
3/10/2010	SW118						5.71	0.75			6.44	
3/24/2010	SW118						4.64	0.708			8.9	
3/29/2010	SW118						22.2	1			7.52	
4/14/2010	SW118						5.29				9.34	
4/27/2010	SW118						5.33	1.25			10.455	
4/28/2010	SW118						12.4	0.833			9.37	
5/12/2010	SW118						5.83	1			12.6	
5/25/2010	SW118						6.33	0.5			11.76	
5/26/2010	SW118						5.21	1			10.97	
6/22/2010	SW118						9.96	0.8333			12.17	
6/28/2010	SW118						20.3	0.8333			10.83	
6/29/2010	SW118						23.3	1			11.78	
7/16/2010	SW118						12.9	0.75			15.83	
7/20/2010	SW118						9.2	3			15.53	
7/29/2010	SW118						21.6	1.5			16.47	
8/24/2010	SW118						8.26	0.833			17.08	

Table A.4 2010 Selected Water Quality Results

Run Date	Site Number	Total Nitrogen (mg/l)	Total Organic Carbon (mg/l)	Total Phosphorus (mg/l)	Total Suspended Solids (mg/l)	Total Volatile Suspended Solids (mg/l)	Turbidity (NTU)	Water Depth (ft)	Water Level (VG) (ft)	Water Temperature - In Situ (deg C)	Water Temperature - pH Lab (deg C)	Zinc (mg/l)
8/25/2010	SW118						9.77	0.833		18.04		
8/31/2010	SW118						8.27	0.833		13.89		
9/8/2010	SW118						9.1	0.917		15.13		
9/9/2010	SW118						7.115	1.25		15.865		
9/14/2010	SW118						25.1	2		13.64		
10/13/2010	SW118						17.4	1.5		10.39		
10/26/2010	SW118						144	0.75	3.5	7.745		
10/27/2010	SW118						28.9	0.583	2	8.58		
11/10/2010	SW118						19.95	1		6.625		
11/15/2010	SW118						15.8	1	-3	7.82		
11/23/2010	SW118											
12/8/2010	SW118						15.2	1		6.34		